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CANADA

DEPARTMENT OF AGRICULTURE

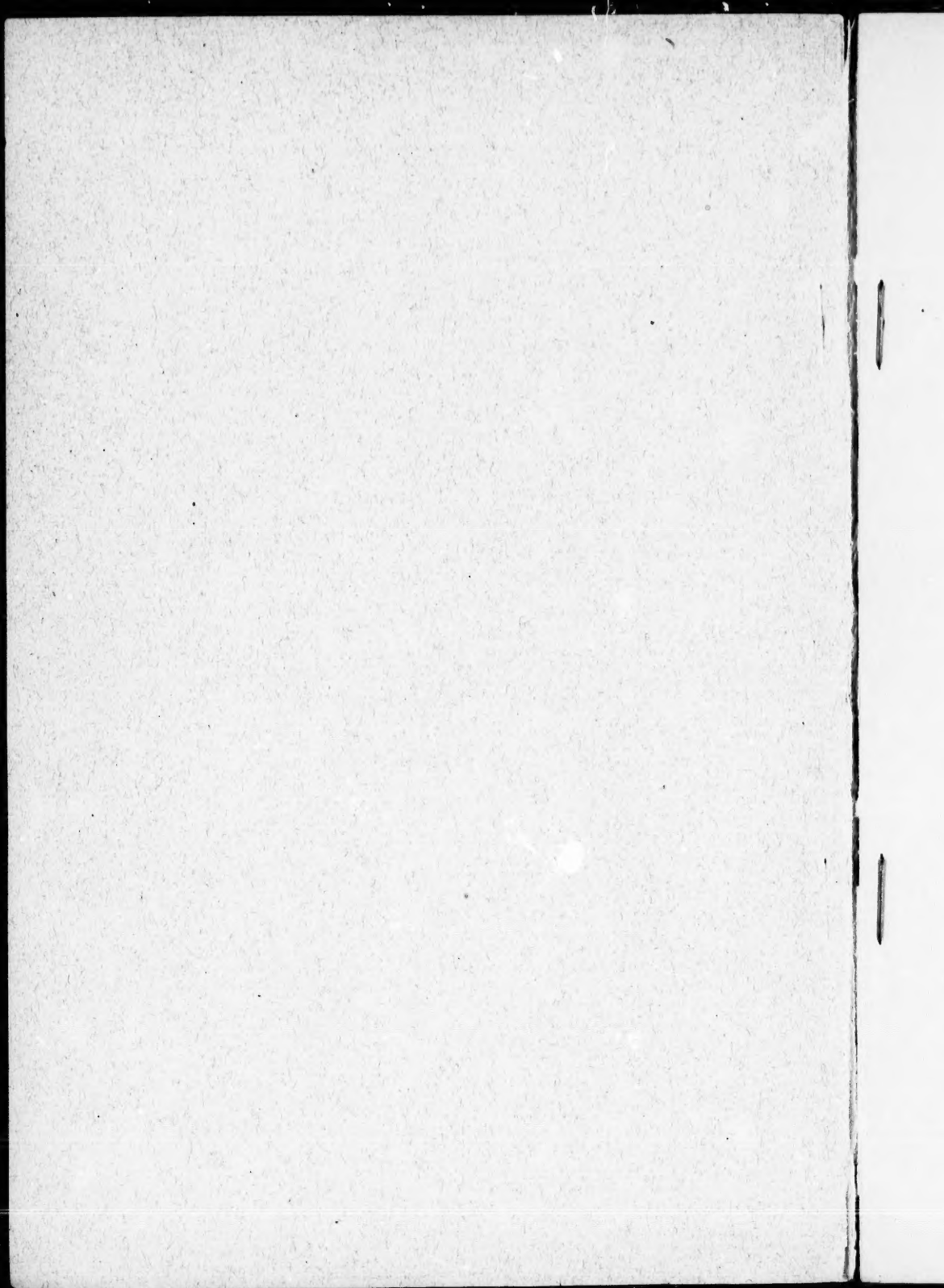
CENTRAL EXPERIMENTAL FARM

REPORT OF THE ENTOMOLOGIST AND BOTANIST

(JAMES FLETCHER, F.R.S.C., F.L.S.)

1894

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REPORT OF THE ENTOMOLOGIST AND BOTANIST

JAMES FLETCHER, F.R.S.C., F.L.S.

WM. SAUNDERS, Esq.,
Director, Dominion Experimental Farms,
Ottawa.

SIR,—I have the honour to hand you herewith a report on some of the more important subjects which have been brought officially under my notice during the past season. In addition to those mentioned in the report, a great many other subjects have been studied, which will be of value on future occasions. The correspondence of this department is now very large; there were received in the year 1894 from January 1st to December 31st, 2,404 letters; and despatched during the same period, 2,465. Contained in the letters received are very valuable data and records of observations by correspondents. These although not used now are carefully preserved, and will be made use of, when the various subjects to which they refer, are treated of in full: among the latter are insect enemies of root crops, fodder crops, vegetables, forest trees and live stock; the important subjects of grasses and weeds, which have been much inquired about, will require extended treatment at an early date. It will be seen that the greater part of the work of the past season, has been with reference to fruit insects. The matter submitted herewith is such as it has appeared to me, was of the greatest importance to bring forward at once, although, in some instances, the information obtained is incomplete. In accordance with an arrangement made last spring, the work upon parasitic fungous diseases is now carried on by Mr. Craig, the Horticulturist.

In the arboretum and botanic garden, a good deal has been done during the past season. A large proportion of the part already laid out and planted, has been seeded down to grass. Extensive additions have been made to the collection of shrubs and trees, and two long borders have been prepared and graded for the reception of the collection of native and foreign perennials. It is hoped to make this an attractive feature of the botanic garden. A large collection of seeds of native plants has now been made, and next year these will be utilized for the botanic garden.

The experiments with native grasses have been continued, and much useful information with regard to the various species tried here and tested by correspondents is being placed on record. The experiments in the treatment of potato rot were this year extremely satisfactory and showed the very great advantage of spraying potatoes with Bordeaux mixture to protect them against the disease. In accordance with your instructions, I prepared for publication, early in July last, a short bulletin (*Experimental Farm Notes*, No. 2) on "Potato Blights." This was widely noticed through the press, and I am pleased to learn that many Canadian farmers tested the remedy and found it satisfactory. Mr. Clarence N. Goodspeed, of Peniac, N. B., writes in regard to spraying potatoes with Bordeaux mixture: "I would say that I sprayed mine twice with very good results. Our land is low and often covered with water by freshets, and seems very liable to potato disease. For the last ten or fifteen years our potatoes have rotted in the ground more or less, sometimes one-third. This year we did not find one potato diseased in our field of four acres. We had some on ground that had been planted two years, some one year, and some never planted before. In this last plot the best results were obtained, and the stalks remained quite green until the crop was dug. I am satisfied with the results obtained."

Many appreciative letters have been received from farmers testifying to the value of the information sent out from this department. I give as an example the following, which relates to one of the most injurious enemies of field crops, but at the same time

one of the most easily controlled. In the beginning of July, Mr. George Thomas, of Jones Falls, Ont., a recent settler in Canada, but who has had an extensive experience as a farmer in England, wrote for a remedy for the "cabbage worm," the caterpillar of the Imported White Cabbage Butterfly, and was recommended to use insect powder diluted with four times its weight of common flour. Reporting on his experience, Mr. Thomas says: "Only for your prompt reply, I should have been the loser of 7,000 cabbages, Brussels sprouts and cauliflowers. I find the white butterfly no respecter of sorts; but it is of conditions, as I noted it was most severe on the weakest plants. I would here respectfully suggest for such the addition of superphosphate, as it is an insecticide and cheap fertilizer, say five cwt. per acre. I think many make the mistake of using the application once and no more. I had to resort to your splendid remedy on three occasions for successive broods, and it effectually eradicated the caterpillars. I had a perfect crop, while many others in this neighbourhood lost their plants by inattention, or maybe through ignorance. I like the idea of mixing with flour, as when applied when the dew is on the leaves it adheres admirably. Such information as this you send and such as is sent by the other departments of the Experimental Farms, is, I believe, of incalculable value to the farmers of Canada, and worth thousands of dollars to those who will make use of it."

Mr. Forrest E. Caldwell, of Manotick, Ont., likewise says: "I consider the bulletin which you sent me concerning insects, has saved me a great deal of money. In the case of wire worms alone, I have two fields of ten acres each, and on these almost every grain crop I have sown for the last twenty years, has been a failure. From what I now know, since I got the farm bulletins, I recognize that the cause of this loss was wire worms and nothing else. Having followed the advice given me at the Experimental Farm, I fully believe I have been saved a considerable sum of money, and I am glad to testify to the value of the institution to all farmers who are wise enough to avail themselves of the advantages it offers. When I received the bulletin above referred to, I had just made up my mind to try a series of several experiments which I had seen recommended in newspapers, and which I now know would have been useless and expensive. By following your advice, I have been saved all this trouble and expense, as well as saved my crop."

Meetings Attended.—By permission of the Hon. Minister, I have been pleased to attend and speak at several meetings of farmers and fruit growers, and I believe that good work has been done in showing farmers the nature of my work and convincing them that it is of value to them, and that when applications are made for information concerning insects and plants, every effort will be made by the Entomologist and Botanist to assist them.

Meetings were attended at the following places:—

January.—Manotick, Ont.; Ingersoll, Ont.; Aylmer, Que.

February.—Montreal, Abbotsford, Cowansville, Chelsea, all in Quebec.

April.—Angus, Ont.; Queenston, Ont.; Knowlton, Que.; Cookshire, Que.; Danville, Que.; Richmond, Que.

June.—Jubilee Point, Rice Lake, Ont.; Riceville, Ont.; Richmond, Ont.

August.—Charlottetown, P. E. I.; Knowlton, Que.

October.—East Tempieton, Que.; Aylmer, Que.

November.—London, Ont.

December.—St. Joseph de Beauce, Que.; Orillia, Ont.

Acknowledgments.—I take pleasure in again gratefully acknowledging the valuable assistance I have received from my many correspondents in all parts of the Dominion, who have much aided the work of my department by making observations and by sending me prompt notice of the occurrence of injurious insects and weeds. My thanks are also particularly due to: Mr. L. O. Howard, the United States Entomologist, and his staff, for many favours in the identification of insects, for the use of figures and for valuable publications; to my kind friend, Miss Eleanor A. Ormerod, for many courtesies and for information concerning crop attacks in England similar to some occurring in Canada, as well as for some valuable books and reports, among others the "Agricultural Zoology"

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of Dr. J. Ritzema Bos, and a collection of the excellent works of Prof. Alfred Nalepa, of Linz, Austria, upon the Phytomyzidae; to Prof. T. D. A. Cockerell, of Las Cruces, New Mexico, for making a careful study of several species of Canadian Coccidae; to Prof. T. A. Williams, of Brookings, South Dakota, for the identification of species of Aphididae, and for the drawing of *Aphis mali*, used in this report; to Prof. L. R. Jones, of Burlington, Vermont, for a series of photographs, illustrating injuries to potatoes by fungous and insect pests.

As in previous years, I am under great obligation to Prof. John Macoun for information concerning the distribution and for identification of native plants.

The following donations have been received in this department during the year:—

W. R. Carles, Esq., British Consul, Chinkiang, China: bulbs of three species of *Lycoris*.

Mrs. Dunsterville, Allahabad, India: bulbs of the Aden lily.

S. A. Fisher, Esq., Knowlton, Quebec: bulbs of *Amaryllis* and *Eucharis amazonica*.

T. N. Willing, Esq., Calgary, Alberta: specimens of rare western plants and insects.

T. E. Bean, Esq., Laggan, Alberta do do

Prof. Comstock, Director, Arizona Experiment Station: roots of the new tanning plant, "Cañaigre," for trial in Canada.

H. B. Small, Esq., Ottawa: seeds of palms from South America.

Frank Gillmor, Esq., Kansas City, Mo.: seeds of *Nelumbium luteum*.

Miss Marion Gordon, Nanaimo, British Columbia: botanical specimens.

J. FLETCHER,

Entomologist and Botanist.

OTTAWA, 31st December, 1894.

CEREALS.

The grain crops of the Dominion have been little injured by insects during the past year. Hessian-fly and Wheat-midge attacks were noticeably less in most of the districts where inquiry was made. The American Frit-fly so destructive to spring wheat in the Ottawa district in 1890, this season could not be found in wheat, and only in small numbers in grasses.

THE GRAIN APHIS (*Siphonophora avenæ*, Fab.) has, as usual, been complained of to some extent from all provinces, but has not been the cause of serious loss. In the Maritime Provinces, particularly in Nova Scotia, a peculiar affection of oats, by which the tips of the leaves turned to a bright crimson hue, was very generally attributed to the attacks of this insect. This however, I believe, was upon insufficient evidence. I visited the Maritime Provinces early in August, and had an opportunity of examining fields of oats and wheat in Prince Edward Island. At that time, there was no trace of the Grain Aphis in the fields, and the oat plants had outgrown the disease. Mr. J. Vroom, of St. Stephen, writes: "July 21. What is the matter with the grain in this section? Nearly all the oats and barley fields are blighted, though it does not seem to be the ordinary blight which the farmers ascribe to unfavourable weather. The newspapers are saying that a 'bug' is in the stalks, but the stalks seem to me all right." Writing later, on Aug. 8, Mr. Vroom says:—"All the oat and barley fields about here are more or less affected, whether sown early or late. By newspaper reports from all the southern counties of New Brunswick, I judge that the disease is widespread, if not general, in this region. At Grand Manan, where seed time is a little later than on the mainland, the fields were quite red in July, after those in this and the neighbouring parishes had apparently recovered from the attack. When first noticed, usually when the plants were about 6 or 8 inches in height, the tips of the leaves were turning red, much redder than in the case of any blight that has been seen here in recent years. An aphid was frequently seen at the base of the diseased leaf, and was by many supposed to be the cause of the trouble. When healthy leaves succeeded and the fields were again turning green, the aphides disappeared. The fields that were under best cultivation, were least affected, the strong and rapid growth of the plants enabling them to quickly outgrow the rust."

Although the cause of this disease is not yet explainable, from such inquiries as I have been able to make, it seems to have been chiefly induced by unfavourable cold wet weather in June, followed by a hot dry period. There were also present in the crimson leaves, and probably the cause of that colour, myriads of a bacillus which was referred to on page 179 of the Experimental Farms report for 1890, in an article by Mr. B. T. Galloway, Chief of the Division of Vegetable Pathology, of the United States, in the following words:—"The germ has been repeatedly obtained from diseased oats and grown in various artificial culture media, such as nutritive gelatine, oat broth, hay infusion, etc. Inoculations with this material have produced the disease in every case. In shape, the organism is sometimes nearly round, although, as a rule, it is several times longer than broad. So very minute is it, that when magnified a thousand times, it is little larger than the head of a pin." It would appear then that the plants were reduced in vigour by unfavourable atmospheric conditions, and were then attacked by this disease, due to a definite and recognizable organism; but that, owing to the removal of the aggravating cause by the improvement of the weather, the plants, particularly and more quickly on well tilled farms, to a large extent outgrew the injury. As opposed to the theory that this disease was due to the attacks of the grain aphid, the "crimson leaf" is of such rare occurrence that, when it first appeared in 1890 as well as this season, it was universally noted as something new; on the other hand, the grain aphid is invariably present in some numbers every year and should, if it were a characteristic of their attack, always produce the crimson leaves, which it does not. Moreover, as was first pointed

out to me by Mr. John R. McKenzie, a progressive farmer, of Roger's Hill, Pictou, N.S., and since confirmed by my own inquiries, although the "red leaf" was prevalent all over the Maritime provinces, the grain aphid was not exceptionally abundant, and was much less so in some districts than is frequently the case.

WIRE WORMS (*Elateridæ*). Several letters inquiring for the best remedy for wire worms have been received. The experience of the past shows that the only one of the many remedies recommended which has given any measure of success is late fall ploughing. Last spring Mr. Forrest E. Caldwell, of Manotick, Ont., called upon me, and in discussing this matter, told me that he had one field in which for the last twenty years every crop of wheat and oats had invariably been badly attacked by wire worms, but that barley and rye in the same fields, as a rule, gave a good crop. To test the immunity of rye, which it was convenient for him to sow this year, I requested him to put the land under that crop, which he did, and he now reports that it was one of the finest crops he ever saw. Fall ploughing Mr. Caldwell has found of little use in controlling wire worms.

GRASSHOPPERS (*Acrydiidæ*). Early in the season several letters of complaint came in of the unusual abundance of young grasshoppers. In most districts heard from, these disappeared suddenly about midsummer. Mr. G. C. Caston, of Craighurst, Ont., attributes this to three parasites which he found occurring abundantly, and describes as the Red Mite, a hair worm and a maggot, the last two being internal parasites, and the mites attacking the insect beneath and at the base of the wings. The severest attack by grasshoppers was upon Sable Island, off Nova Scotia, and was brought to my notice by the Department of Marine and Fisheries, with a request for suggestions as to their extermination. It was stated that the locusts sent had been very abundant on Sable Island the past summer, and had injured the grass and vegetables to such an extent that the agent of the department feared there would be a scarcity of fodder for the wild ponies during the coming winter. In forwarding the specimens, Mr. J. Parsons wrote: "Some three or four years ago a few were noticed for the first time on the island; the following year there were more, and in the summer of 1893 they were numerous. This season they infest the island. All the cultivated vegetables have been injured, and the grass crop greatly reduced. Whether brought to the island in hay or by wind, or whether the eggs have hatched after being long buried, the superintendent does not know." There is no doubt, I think, that the progenitors of the present invasion



Fig. 1. The Rocky Mountain Locust.

were blown from the mainland, as they have been found at sea at a much greater distance from land. From all I can learn of the nature of Sable Island, I judge that this colony of grasshoppers could be easily controlled there by the use of hopper-dozers, as recommended on page 166 of my last year's report, in which the young could be caught and destroyed before their wings appeared. The species of grasshopper concerned was the Lesser Migratory Locust (*Melanoplus atlantis*, Riley). Fig. 1 represents the Rocky Mountain Locust; the present species closely resembles it in shape, but is one-third smaller in size.

THE PEA MOTH.

(*Semasia* sp.)

Attack.—Small whitish and slightly hairy caterpillars, when full grown about half an inch in length, frequently found inside the pods of pease about the time they are ready for table use, or a little later.

"Maggoty" or "wormy" pease are well known to the house-keeper, but it is seldom that they are sufficiently abundant in gardens to cause much complaint, and I do not think that anything has been yet written in this country upon the life history of the insect of which these "worms" are one of the preparatory stages. Owing to the

immunity of certain districts in Canada from the attacks of the Pea Weevil, *Bruchus pisi*, L., large quantities of seed pease have of late years been grown in these districts for European and American seed houses. Late last season and during the present summer, complaints have come in of the ravages of the Pea Moth, the caterpillar of which is generally spoken of in the trade as the "grub." Mr. N. H. Cowdry, an extensive grain merchant, of Lindsay, Ont., writes:—

"We have no 'pea bugs' in this section; but the 'grubs' seem to be nearly as bad a pest; our farmers know no way to prevent the attack."

Messrs. N. B. Keeney and Son, of LeRoy, N. Y., wrote to me as follows:—

"November, 18, 1893.—We are growing pease for the seed trade in the counties east of Toronto, Ont., and also in Northern Michigan. The principal obstacle we encounter in our Canadian field, is the injury by a worm which works inside the pea pod and eats the outside of the green pea when it is in suitable condition for cooking. The injury done by this worm frequently results in destroying the usefulness of from 10 to 20 per cent of the crop, and we would like to know if there is any possible means of preventing the work of this worm."

"June 29, 1894.—We shall be glad to have instructions from you and will follow same to our best ability, and we hope a remedy may be discovered for this very serious hindrance to the prosperity of Canadian pea growers. This insect has never worked, to any extent, on this side of the line, so far as we have been able to learn; nor have we ever seen it in Northern Michigan, notwithstanding we have shipped Canadian grown pease to Michigan for seed."

Several specimens of the larvæ were from time to time forwarded to me by Mr. N. H. Cowdry and Messrs. Keeney and Son's agents, and these are now passing the winter as larvæ inside their cocoons. Next spring I hope to obtain the perfect insect, which is undoubtedly a small moth and may possibly prove to be the European Pea Moth, *Semasia nebrittana*, Treits. (*Grapholitha pisana*, Gn.). The preparatory stages and the habits of the insect, as far as worked out, all agree closely with those of the European species, as figured and described in Curtis's Farm Insects, page 348, and Miss Ormerod's valuable Manual of Injurious Insects, page 163. Miss Ormerod's description of the English species is as follows:—

"These caterpillars or maggots are fleshy and slightly hairy, about or somewhat more than a quarter of an inch in length, and are generally yellowish in colour, with a black head, a brown band on the ring next to the head, and eight brown dots on most of the following rings. They sometimes, however, vary in colour; in some specimens the head and the next ring are brown, and in some they are intensely black. The legs on the three rings next to the head are black."

"The caterpillars go down into the earth to change, where they spin a cocoon (that is, a kind of egg-shaped covering formed of silken threads drawn from the mouth) in which they remain till spring, when they turn to chrysalids, out of which the moths appear in June."

"The moths are rather more than half an inch in the spread of the wings, satiny, and mouse-coloured. The upper wings have a row of very short white streaks directed backwards from the front edge, and a silvery oval ring with five short black lines inside it placed near the hinder margin."

The following account of the habits of this insect is from the *Agricultural Zoology* of Dr. J. Ritzema Bos (London, 1894):—

"The moths fly about in large numbers round the pea blossoms, always a short time after sunset. The females lay one, two, or at most three eggs on a very young pod, or an ovary. In fourteen days the caterpillar is hatched, bores into the pod, and attacks the pease. The opening made in the margin of the pod closes up again. The pod generally ripens early. When it opens, the full-grown caterpillars creep out, and become pupæ in the soil, within a web, where the pupa lives through the winter. The pease attacked are always covered, while in the pod, with the coarse-grained excrement of the caterpillars, and are often united two or three together by web fibres."

Commenting on the above, Mr. Cowdry writes:—"The pods here seldom open naturally, and I think do not ripen early. The quantity of excrement and web fibres is

not so large in this country." This agrees with what I have myself seen. In fact, of a great many pods examined, I have never seen one which opened of itself; but in all cases, the larva has eaten a clean, round hole through the side of the pod, and the quantity of excrement and web is small.

In reply to a letter of inquiry, the following has been received from Professor C. H. Fernald, the eminent microlepidopterist, of Amherst, Mass.:—"I would say that I have never seen, nor heard of *Grapholitha pisana*, Gn., (more properly named *Semasia nebritana*, Treits.) in this country, nor of any similar insect attacking pease."

The species which attacks our Canadian pease appears to be widely distributed, and probably attacks also the seeds of other Leguminosæ. The extent of the injury in part of the seed-pea growing districts of Ontario is referred to in the extracts given below. The injury to pease was noticed also, west of Toronto, in Essex county, about Hamilton and London; also in several places in the province of Quebec, in Nova Scotia, very bad in some parts in New Brunswick and in Prince Edward Island. In collecting seeds of native plants for the Farm museum, I found that the seeds of *Lathyrus ochroleucus* and *L. palustris* at East Templeton, Que., were almost entirely destroyed in every pod examined; likewise at Ottawa the seeds of the new fodder plant *Lathyrus sylvestris-Wagneri* on this farm and *Vicia cracca* growing wild were seriously attacked.

As far as I can judge from the observations of the past year, the egg is probably laid upon the young forming pods, either before or soon after the flowers have fallen, but occasionally later, as Mr. Cowdry found quite small caterpillars on July 27, when most of the larvæ were full-grown. The egg is laid on the outside of the pod, and the young caterpillar eats its way into it. At that time, it is of course very small, and the hole is soon obliterated by the natural growth of the pod.

The caterpillar then begins to feed upon one of the seeds, generally at the upper end. Sometimes, only one pea is injured, but frequently two or three are more or less eaten. The caterpillar having attained full growth about the last week in July, gnaws a small round hole through the pod, from which it falls to the ground, and burrowing a short distance into the earth, spins a thin but close oval cocoon of white silk, thickly covered outside with grains of earth, in which it remains torpid until the following spring. It then changes to the chrysalis, and the perfect moth appears about the time the peas are in flower. There is only one brood in the season. The following extracts from letters by Mr. N. H. Cowdry, who is a careful observer and an experienced entomologist, give many valuable data concerning the life history of the insect:—

"June 9, 1894.—I send you by to-day's mail two pea plants, each with one pod tied up inclosing the caterpillar. Mr. Keeney, of Le Roy, N.Y., and I took a drive in the country last Saturday and looked over plenty of material, but only found the specimens sent you. It is likely, therefore, that they have not damaged the early varieties of pease this year to much extent, or the excessive rain may have diminished their numbers."

"July 17.—So far, I have not yet found the moth, but suspect that it may be identical with two specimens which I was unable to catch. They were about a third of an inch long, whitish with brown markings. Almost all the pease infested, were full sized, never very young and only partially matured. Often, however, the small pea at one end of the pod in almost matured pods would be damaged, but only those very small ones which would not mature. I could never find any trace of the caterpillar in very immature pods, only in those in which the pease were nearly or quite matured. So far, I have only examined crops of Extra Early, Alaska and American Wonder, all of which will be harvested this week.

"About when or where the egg is laid, I can give you no information, but it appears to me that the larva generally begins its work near the upper end of the pea. From the very immature larvæ that I have observed in nearly mature pease, I think it very unlikely that the egg is deposited on the flower, and I have never been able to find any trace of the passage of the caterpillar through the pod. It is very probable that numbers of the pupæ can be found under the bunches of pea straw in the fields."

"July 27.—I opened several pods in the field and noticed as before that no very immature pods were attacked. The small abortive pease in the green, partially matured

peas, were often eaten, however. The caterpillar as so far appeared to give its attention solely to partially matured pods, never to very immature pods, and (so far as I have noticed) not as yet to pods nearly or wholly dried and mature. What does this mean? I find the caterpillar (both very small and apparently nearly ready to change into a chrysalis) in almost fully developed pods, never in very ripe or very green flat ones. The assumption is that the caterpillar only works with partially matured peas. How is it then that I have never found as yet this season fully matured pods at all damaged, although I have opened several? I confess that this fact rather puzzles me.

"Now, as to the date when the caterpillar finishes its work, I send you to-day unopened a pod with a hole in it, the first which I have seen. You will probably see, when you open it, that it contains some damaged peas only and not the cause of the trouble. In the same box you will notice a caterpillar which appeared to me to be ready to pupate, and the pod in which it was contained. Judging from the perforated pod and the mature look of some of the caterpillars, I imagine that the larvæ are only now reaching full growth. Some, however, which I saw yesterday are very young, not many days old. Either the season for oviposition is very extended, or we have two species or two forms of the same moth to deal with.

"With the exception of the crop which I examined to-day, all the early varieties have been harvested. Some will be threshed very soon, others not perhaps for some weeks. I will try to find the chrysalis. I think that it will be found under straw in barns or somewhere thereabout.

"You say that only in late years the damage has been so great as to attract attention. Farmers and dealers here say the damage of late years has not been greater than before. That they have always noticed the injury and sometimes as causing more loss than now."

"July 30.—I now want to find out where the pupæ are to be found. So far I have not found any quite mature pods with either damaged peas or caterpillars in them, probably because they matured too early to be affected, and not that the caterpillar cannot eat the hard, mature peas. In a bin of Black eyes of last year's growth I find that by far the larger number of damaged peas are quite mature, proving, I think, that the larva continues to feed on them until full grown, whether the peas are hard or not."

"August 3.—I examined a crop of dwarf peas last Wednesday, and found that a portion grown on low land, badly stunted by wet, was very much injured by the caterpillar, while the higher portions of the field escaped serious damage from it. During the winter, when the farmers bring in their peas, I hope to get some evidence as to the influence of sowing early or late, on high or low land, &c. In a crop of dwarf peas which I examined on the 1st of August, nearly all the grubs had finished their work and left the pods."

"October 22.—In accordance with your request of some months ago, I send you to-day some perforated pea pods. Also in a pill box the only cocoon which I have found naturally placed. It was found in a pea field, loosely attached to the under surface of a stone.

"Early peas this year escaped with very little injury from the caterpillar. The later common peas are damaged to about the same extent as in the average of former years. The damage this year is certainly less than in some seasons past, but greater than in others."

"December 22.—The farmers here are almost all of the opinion that early sown peas escape the caterpillar better than those sown later. One or two say that very late sowing is of benefit; but this is opposed by the general opinion. Early peas are always damaged less than late peas, although I hear that early ripening varieties are sometimes badly damaged. They have, however, I believe, a much better chance than later ripening varieties. High ground is supposed to produce crops more free from 'worm' eaten peas than low land. Some farmers think that peas are more liable to damage in dry seasons than in wet ones. Regarding the time during which the damage is done, I do not know when it begins, but I think it only ends when the peas get too hard to gnaw. I noticed several caterpillars (one only half grown) on August 23 in a small lot of late garden peas. I opened a cocoon a few days ago, and found the

caterpillar very slightly changed. It was, of course, shorter, and with the legs much drawn in, but otherwise not at all like a chrysalis."

The following letter is from a large buyer of seed pease, and gives reliable information as to the importance of finding a remedy as soon as possible for this serious pest:

"December 31, 1894.—Replying to your valued favour of 22nd December, the damage done to the pea crop in this vicinity by the Pea Moth, concerning which I wrote you last summer, has steadily increased during the last six years until now it has come to be a very serious matter. Many crops, especially such as have to be fit for seed, contain from 5 to 25 per cent of moth-eaten pease which have to be picked out by hand at great expense, in order to make the sample a satisfactory one. I do not know of any remedy for this evil.

"Our farmers find that pease grown after pease are apt to be more seriously affected than pease grown after sod, but even in cases of this kind the damage is frequently very considerable, especially in smooth varieties of pease. Am very much in hopes your investigation may result in discoveries which will enable our farmers to successfully combat this serious enemy of the pea crop and restore the pea-growing industry to its former prosperity."—J. M. BROOKS.

Remedies.—There is little danger of this insect increasing largely and becoming a serious pest in gardens, because in most instances, the pease are picked early, and the larvæ destroyed before they are full grown. Miss Ormerod suggests that where "maggot attack is noticeable, the pea haulm should be cleared away directly the crop is gathered, so that all stray pods (which are very likely to be infested) may be cleared off the ground before the maggots leave the pods. This haulm should be carefully destroyed at once; the safest way is to burn it, and it would be a good plan to lay it along the rows where the infested peas stood and burn it there, so as to get rid at once of all grubs remaining in the pods or near the surface of the ground. For field treatment, as the haulm could not well be spared, it would be desirable if a pea growing district was infested, to plough deeply so as to bury the chrysalids deeply; or to skim the surface lightly so as to lay them open to the attacks of birds; but commonly the regular rotation of crops might be expected to prevent this infestation getting ahead." (*Manual*, p. 164.)

From my own breeding experiments as well as from Mr. Cowdry's collections in the fields, we know that this insect normally passes the winter in the fields where the pease which the caterpillars had infested, were grown. This fact seems to be recognized by pea-growers. Messrs. N. B. Keeney & Son write:—

"Le Roy, N. Y., July 24.—There seems to be a theory among farmers that pease grown on fields where pease have been previously grown are more likely to have worms than crops grown where pease have not been previously grown for some years. This would seem to confirm your belief that the caterpillars spin their cocoons near the surface of the soil."

"August 6.—We cannot give you the names of farmers who state that pease grown on land previously cropped to pease are more liable to attack from the insect under discussion than new land; but this is the general opinion among all growers, and they try to avoid growing pease after pease, as far as possible, on this account, as well as to avoid the danger of impoverishing the soil."

The above records will show the importance of three things: (1) the planting of pease as early as possible, and for a time at any rate growing the earliest ripening varieties only, in an infested locality; (2) the advisability of using every year fresh land, as far as possible removed from fields used before for the cultivation of seed pease; (3) the value of deep ploughing so as to bury the chrysalids so deep that the moths could not emerge. If, as suggested by Miss Ormerod, applications can be made to the growing crop in order to prevent the moths laying their eggs, the most suitable for the purpose would probably be carbolized plaster, or some other carbolized dry powder such as wood ashes or slaked lime, 1 pint of crude carbohc acid with 50 pounds of the diluent.

Mr. Cowdry writes with regard to remedies:—"I think ploughing deeply so as to bury the cocoons far enough to prevent the moths from getting to the surface, is preferable to shallow ploughing; as it is probable, if the cocoons are on the surface, that they would withstand the frost and not be a very tempting morsel for birds.

"When a crop is badly infested, I think it would be well to cut it before it is quite mature; most of the larvæ would then be taken into the barn, where the conditions would not be so favourable for their development, and those which did survive and become moths, would have less chance of doing damage next season. Harvesting when not quite mature, would not materially affect the value of the crop, which would already be damaged by the caterpillars. Sowing oats and pease together I think is well worth a careful trial, especially when good seed is required. The pease can easily be separated from the oats by a fanning mill."

THE ARMY WORM.

(*Leucania unipuncta*, Haw.)



Fig. 2.—The Army Worm.

Attack.—Brown, or sometimes blackish, striped caterpillars (Fig. 2), eating the leaves and stripping the stems of grasses and many other low plants. When attacking cereals, frequently cutting off the heads. When full-grown, over an inch and a half in length, and, when occurring in large numbers, migrating in bodies from one food patch to another. On reaching full growth, the caterpillars burrow into the ground and turn to light brown chrysalids, from which in about two or three weeks the moths emerge.

These (Fig. 3) are of a warm satiny-brown colour sprinkled with minute black specks and with a small but distinct white spot in the middle of each upper wing. They are very active. When the wings are closed, the moth measures about an inch in length.



Fig. 3. — Chrysalis and moth of the Army Worm.

The life-history of the Army Worm in Canada is as follows: There are two broods in the year. Eggs are laid in autumn and hatch in ten or twelve days. After feeding for a short time, the small caterpillars, like many of the cut-worms, become torpid and pass the winter beneath tufts of grass and other low herbage. In the following spring they complete their growth, feeding on the young grass and grain crops, and produce the moths in June. These lay eggs for the second brood, which is usually much the more abundant and destructive. By the latter part of July, in this part of Canada, the young caterpillars are large enough, when abundant, to attract attention by their depredations. They are full grown by about the first week in August, when, burrowing an inch or two into the ground, they change to chrysalids and emerge as perfect moths towards the end of the month.

The chief complaints of depredations by the Army Worm this season have been received from North-western Ontario, along the line of the Canadian Pacific Railway.

"Mattawa, Ont., July 11.—Inclosed you will find specimens of a worm or caterpillar which is invading gardens and fields in myriads. It has already done considerable damage to corn, and is now attacking everything else, and I am afraid it will destroy everything, unless you can advise some remedy. We have more or less of them every season."—C. G. HURDMAN.

"Baillieboro', Ont., July 16.—I am sending you a sample of worms which have got into my pasture. They eat everything and appear to increase very rapidly. It is low, flat land, such as they call 'beaver meadow.'"—R. H. WOOD.

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"Sturgeon Falls, Ont., July 17.—It is reported that a small black worm or caterpillar, about one inch long, is making considerable havoc in our locality. This insect attacks oats especially, the leaves of which it eats up, leaving only the stem; the ground is all covered with them. Last year this insect made its appearance in the neighbouring township, Caldwell; but there were none here."—JOSEPH GUÉRIN.

"Mattawa, Ont., July 23.—On a farm of mine some 26 miles from here, on the Ottawa river, an army of the most destructive bugs have made their appearance, and seem likely to entirely destroy the late sown timothy grass, oats and corn. It is a dark coloured grub, black on back, striped lengthwise with lighter markings, lighter coloured on the under side. They feed on the tender leaves of corn at night and hide in the centre of the shoots during the day, and on oats they hide under anything on the ground that affords them a shelter. They are completely destroying oats. Please let me know what can be done to stop the ravages of this, to me, new pest. Could I use an insecticide on corn?"—A. LUMSDEN.

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In the reply on July 24, the insect was named, and then its habits were described. "With regard to an insecticide, it is of course very difficult to apply any remedy to such a crop as timothy, and I should imagine at this time that that crop is sufficiently advanced to be cut. The fields might then be rolled to destroy the caterpillars. It is even more difficult to make any application to corn, and the only one that occurs to me as likely to be practicable, would be dusting the plants with a mixture of Paris green and flour, wood-ashes, land plaster, or any other fine and perfectly dry powder, in the proportion of one pound of Paris green to 50 of the powder."



"August 1.—Since the reception of your letter of July 24th, I have visited my farm and found it to be an army worm that was destroying the crops there. I am anxious to know of some method of compassing their destruction, and told my farmer to follow out your suggestions, as well as one of my own, of giving them shelter under straw in the early morning and then burning it in the heat of the day, say 2 p.m. Where the oats, timothy and clover plants grow, the young feed first on the grass, then attack the oats, but rarely touch clover, as is evidenced by a field seeded to grass last year, when they first appeared. This year there is an immense growth of clover, but not one blade of timothy, and they are doing the same thing this season. I had my men kill them out of the corn, which is now getting past them. I find the grubs are now entering the second stage of their existence, and I find them in large numbers about an inch under the surface of the ground, at the roots of plants. Will these remain hibernating all fall and winter, or may we expect a destroying army this fall again? Could you suggest some method of destroying them in the soil, or would fires kept burning in June at night, catch the moths? I found the worm in destructive force as far north as the upper end of Lake Temiscamingue, 325 miles from here."—A. LUMSDEN.

The following letter was received from the *Farmer's Advocate*, of Winnipeg, with some specimens of ears of wheat, the chaff of which had been much nibbled on the outside:—

"I send by mail a few specimens of the caterpillar that has done such havoc to the wheat during the exhibition week. When I left home on Thursday, there was nothing to be seen. On Sunday the whole field was covered; by Wednesday almost every head was the same as those I inclose, and every leaf stripped from the stock. By Sunday they had pretty well disappeared, and had apparently gone into the ground to turn into the chrysalis state, and I inclose a few in that condition. They have only appeared in the new land and summer fallow, but far worse on the new land. I hope you will be able to find out what they are and say whether they are likely to appear next year."—JAMES GLENNIE.

In *The North-west Farmer* for August, 1894, is an article on the Army Worm, in which the statement is made that the caterpillar was reported by visitors at the Winnipeg Industrial Exhibition to have been seen in considerable force on wheat crops 15 or 20 miles north-west of Portage la Prairie.

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Remedies.—Although only occurring occasionally in excessive numbers, and then in but few localities, this moth is very widely distributed in Canada, and may generally be found in most parts in low lands where the caterpillars have suitable conditions for growth and an abundance of food. It has also been observed that the Army Worm is most abundant in wet seasons following a dry autumn, the damp weather giving them the same conditions over a large area as they would find in their own special habitat, viz., low, swampy, and grassy places.

When the caterpillars appear only in moderate numbers, they have an abundant food supply, and do not then acquire the habit of "marching," which is merely moving from one place where all the food has been devoured, to a fresh pasture. When, however, their appearance is excessive, they must of necessity move on to some other place or starve. They may be prevented from marching from one field to another by ploughing a deep furrow across their path. This should be cleared out so as to have the edge nearest to the field to be protected, perpendicular or slightly overhanging. Along the trench so formed, pits must be dug about 12 feet apart. When the caterpillars come to the trench, they are unable to climb up the opposite side, and after a few trials, walk along until they fall into the pits, when they may be destroyed by covering them with earth and tramping it down, or, as Prof. Lugg, of Minnesota, suggests, "with a liberal dose of kerosene oil and water. Even a shallow ditch will answer this purpose if the earth is made friable enough to keep the worms from ascending. If a log is dragged continually through such a ditch, nearly all the worms collected there are either killed or maimed."

If pits are not dug, where the caterpillars occur in large numbers, the trench will soon be filled, and they will walk over on the bodies of their fellows. In case any of the worms succeed in crossing the ditch, a narrow strip of the plants on the opposite side of the trench should be dusted or sprinkled with a strong mixture of Paris green diluted either with 25 times its weight of flour, ashes or land plaster, or mixed with water as strong as one ounce to a pailful of water.

When an attack has been very severe in any locality, much good may be done by burning the old grass and stubble in autumn or spring; in this way many of the young larvae are destroyed, as well as the old stems, which it seems are the favourite place for the spring brood of moths to lay their eggs upon.

An encouraging feature in connection with an invasion by the Army Worm, is the fact that it is extremely rare for the insects to appear in large numbers two years running in the same place. This is due to the fact that they are almost invariably attended by parasitic foes, which destroy them so effectually that the occurrence of two "Army Worm years" in the same locality is almost unknown.

FRUITS.

The following concise report on the fruit crops of the year has been kindly supplied by my colleague, Mr. John Craig: "Apples were a light crop in Southern Ontario and a fair to good crop in the eastern part of the province, as well as in Quebec and Nova Scotia. There was an exceptionally large crop of pears and of unusually good quality. All young, well cultivated peach orchards gave a heavy yield; neither rot nor curculio seem to have done much damage; thinning in many instances would have been advantageous. Plums and cherries were a good crop, but suffered considerably from rot and curculio. Of small fruits, grapes yielded and ripened well everywhere; raspberries were a light crop in Eastern Ontario and Quebec, owing to injuries sustained during the previous winter. In Western and Southern Ontario the crop was light also on account of dry weather. Strawberries were injured in Central and Southern Ontario by late frost; in Eastern Ontario and Quebec the crop was heavy, but the fruit soft on account of continued wet weather during the picking season. Other small fruits yielded heavily."



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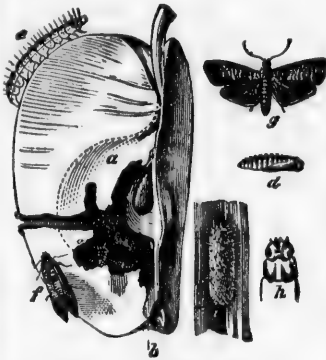


Fig. 4.—The Codling Moth.

THE CODLING MOTH (*Carpocapsa pomonella*, L. Fig. 4) was last season a cause of great loss in all parts of Canada where this insect occurs. A great many letters have been received not only concerning its depredations, but testifying to the great value of spraying with the arsenites. The experience of the past enables us to state positively that Paris green in the proportion of one pound to 200 gallons of water, to which one pound of lime has been added, sprayed over the apple trees by means of spraying pump and nozzle, at the time the eggs are laid, is the best, cheapest and most effective remedy for this insect.

Careful observations made during the last ten years convince me that in this part of Canada there is only one regular brood of this insect in the year. This is, I believe, the case as far west as Toronto. In the fruit-growing districts of Western Ontario there are two broods. Prof. Saunders tells me that about London, Ont., during his long experience there as a fruit-grower, the second brood was invariably the more destructive. In California there are known to be at least three broods. It is claimed that so far there is no authentic record of this insect having been found breeding in British Columbia. Should it get introduced, it is probable that there would be two or three broods. The British Columbian Government have wisely adopted stringent measures to prevent the introduction of such a serious pest.

Referring to the second brood of the Codling Moth, Mr. L. Woolverton writes as follows:—

"Grimsby, Ont., Dec. 21.—The late brood of the Codling Moth did much harm to the ripening fruit and needs more careful attention in future. The injury done by this insect in Canadian orchards must amount to hundreds of thousands of dollars annually. If our practical fruit growers could be induced more generally to use faithfully those methods for insect destruction pointed out by yourself and other careful experimenters, it would result in an immense increase in the profits of their business. The trouble is that they only half try the remedies, if at all, and then lose faith because they do not secure such good results as they expect."

As to the extent of the injury by the second brood, Mr. Murray Pettit writes:—
"Winona, Ont., Nov. 7.—In reply to your inquiry *in re* Codling Moth, the late brood was much worse this season in this locality than ever before to my knowledge. I think fully one-third of the Bartlett, Flemish Beauty and Kieffer pears ripened before attaining full size. Some dropped, and part of them were picked with those naturally ripened."

Mr. A. W. Peart, a careful experimenter, writes as follows:—"Freeman, Ont., April 10.—As you are aware, I have been spraying for several years. Paris Green I find effective against the Codling Moth, but am not so certain about its effects on the curculio. I have used lime in water with Paris green of usual quality, and find no damage to foliage."

"December 10.—I have sprayed for Codling Moth for many years and am satisfied that I check its ravages in a measure. This year the proportion of worms was larger than for years; but this I account for by the rains interfering with the action of the poison, and the unusually light crop of apples; the lighter the crop, the more worms relatively, is, I think, about an axiom, as well as the converse: the heavier the crop, the fewer the worms are in proportion. The curculio was also bad; in fact, I do not remember any year during the last decade, which produced so many insects and fungous pests. We shall certainly have to take more energetic measures to cope with these pests than we have in the past, if we want to make fruit growing profitable."

The following extract is from Bulletin 52, Ontario Bureau of Industries, Toronto, November 20th, 1894:

"Gosfield, S., Essex: There have been a few local tests of spraying apple trees. Where they have been sprayed three or four times at intervals the results have been almost marvellous—large, fine, clean, almost perfect fruit,—packers from Huron County say the best they have ever handled. On orchards near by not sprayed there have been but few apples gathered, and these hardly worth the name, being little, gnarled, wormy and scabby."

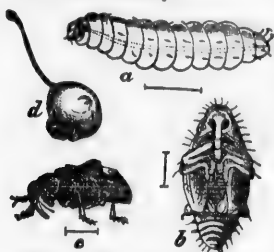


Fig. 5.—The Plum Curculio.

as bad, that either fell off early or I removed them from the tree myself. Much of this injury I attribute to the curculio; there being no plums, the curculio stings the apples, and it is ten times worse than the Codling Moth, for it makes apples gnarled, bitter, hard and woody, in fact, utterly worthless. The experience of this year satisfies me that we must spray or cut down our trees."

Mr. Robert Jack, of Chateauguay, Quebec, gives the names of the following varieties as being particularly subject to injuries by the curculio: Duchess, Yellow Transparent, Grimes's Golden.

Although opinions differ as to the extent of immunity of a crop sprayed with Paris green from attack by the Plum Curculio, there is, no doubt, sufficient benefit to make this method still the cheapest and most practical. The following letter is from Mr. G. W. Cline, of Winona, Ont., probably one of the most extensive and successful plum growers in Ontario:—

"December 19.—My crop of plums was saved this season by spraying five times with 3 ounces Paris green to a 40 gallon barrel of water kept well stirred. I usually spray from four to six times, according to the wetness of the season, beginning at the time the covering of the young plum is just bursting open, never before, as I find the curculio does not begin to bite before warm weather, which begins about that time. I have always saved my crop for some twelve years, when I have sprayed at proper time and kept it up as required, and would not return to the jarring process again under any consideration. I never use any lime with Paris green, and never had but a few cases of trees scorched on one side, when the men were sucking the water too close to the bottom of the barrel, which had not been properly stirred. If the mixture is kept well stirred, I find no trouble in saving my crop always from the curculio."

Mr. James Stewart, of Meaford, Ont., writes:—"I have sprayed my plums for two or three years, and I have found a great benefit in so doing. Last spring I sprayed when the fruit was nicely formed, and a second time in about two weeks. As a result, I had a splendid crop of plums. I am certain there was not a pint of plums fell from the trees, and I know that some of my neighbours who did not spray, lost nearly all their plums."

THE PLUM CURCULIO (*Conotrachelus nenuphar*, Herbst, fig. 5.)—Plums and apples in some districts, have been severely attacked during the season, but peaches less than usual, by the Plum Curculio. Owing to the enormous crop of peaches, the limited destruction by the curculio and rot is thought by Mr. Craig to have been a benefit to the main crop. A great many letters have been received from Ontario and Quebec, complaining of the work of this weevil on plums. Its depredations on apples were also noted. Mr. T. W. Ramm, writing from Ross Mount, Ont., on August 24, says:—"I send you the worst specimen of an apple that has ever been seen on my place, and I had hundreds about

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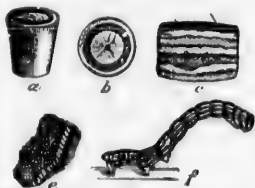


Fig. 6.—Fall Canker-worm: a, b, side and end view of egg; c, mass of eggs; f, caterpillar; e, enlarged segment of caterpillar.

dead moths on the trees. Their bodies were rigid and firm. Upon pressing them with the small blade of a knife, they offered such a peculiar and strong resistance that I concluded they must be frozen. There has been a heavy rain since; and the moths have been washed to the ground among the clover, and are hard to find. Living females are still climbing the trees. I first noticed the female moths climbing the trees about the middle of October, and they are still moving, though in fewer numbers at this date. In my experience, both in this and previous years, the Canker-worm is confined almost exclusively to the Northern Spy, although many other varieties of apple are adjacent to and scattered among the Spys. Spraying with me was not very satisfactory this year, on account of the frequent rain falls during the spraying season. However, I did manage to keep the Canker-worm in check fairly well by the use of Paris green, one pound to 200 gallons of water, with a little lime added."



Fig. 7.—The Shot-borer.

THE SHOT-BORER (*Xyleborus dispar*, Fab., Fig. 7.). Some useful observations have been made on the habits and life history of this injurious enemy of the apple and plum. Some of these I give herewith.

"Church Street, N. S., May 8.—Have been examining my apple trees to see if the borers are at work yet. I cannot find any nor any of their fresh work."

"June 7.—In your last letter you wished me to keep watch for the apple borer. Have been working among young apple trees every day this spring, and on June 2, I saw the first and only one this spring, and this in a young tree in an old orchard."—LEANDER WOODWORTH.

In 1893 Mr. Leander Woodworth wrote to me that he had seen the beetles at work on the bark on June 10.

"Berwick, N. S., December 2, 1893.—I first discovered the borers last spring, when I found 25 of my best young trees with the bark turning red, and upon examination found them full of borers. I cut down all but a few and burned them. I washed all my young trees with lime in June. Then I made a wash of soft soap, 1 gallon; water, 3 gallons; carbolic acid, $\frac{1}{2}$ pint, and washed the trees with this mixture twice in June, once in July and once in August. I have examined the trees carefully and cannot find any work of the borers this year. The trees that had the borers in them were young, healthy, fine-growing trees, as good as any that could be found in the valley."—JOHN S. WOODWORTH.

"Berwick, N. S., December 1, 1893.—I do not know for certain at what time the borers begin to attack the trees, but I think about the end of May. As far as I know, Gravenstein trees (young ones) seem to suffer most, and I am of opinion that the borer will attack healthy trees as well as diseased ones."—W. H. WOODWORTH.

From the above it would seem that preventive washes should be put on the trees from the beginning of May; three washes one month apart would probably be sufficient.

THE OBLIQUE-BANDED LEAF-ROLLER (*Cacacia rosaceana*, Harris) has caused considerable damage to fruit in some districts during the past season. It not unfrequently is troublesome on apple trees and currant bushes; but this year it was sent to me as an enemy of birch, apple, pear, gooseberry and black currant. Three unusual and interesting attacks were: on garden geraniums in which the leaves were eaten; on the Silver

Maple (*Acer dasycarpum*), when the seeds only were attacked and hollowed out; and on the pear, where the caterpillars not only destroyed the leaves, but were particularly injurious to the young fruit, eating large cavities into the forming pears, in the same way as Professor Gillette describes the attack of the allied *Cacacia argyrospila*, Walker, on apples. (*Bul.* 19, *Colorado State Agricultural College*, 1892.) Mr. J. S. Freeman, of Free-man, Ont., in sending the specimens writes:—"June 13. The inclosed worms are eating the pears they are sent with. I believe they have destroyed $\frac{1}{5}$ of my Bartlett's by eating the skin off and holes into them." Mr. C. P. Morgan, Truro, N. S., complained of them attacking his gooseberry and currant bushes, and also notes them as injuring plum and apple trees. Spraying with Paris green is an effective remedy.



Fig. 8.—The Pear Slug.

water to 1 pound of Paris green. Fruit-growers are now recognizing the danger of neglecting insects, and I believe in future a more thorough system will be adopted for their destruction." In using Paris green for spraying, an equal quantity of fresh lime should always be added, particularly upon plums and peaches.

The following interesting letter refers also to the same insect:—"Burlington, Ont. —My pear orchard consists of about 1,300 trees, more than half of which are Bartlett's. These suffered particularly last season from a dark-coloured slug which ate the substance of the leaf, leaving only the skeleton. The work was done very quickly. After an absence of a few days from the orchard, I found this one variety brown from end to end of the row, Clapp's Favourite, Boussock and Anjou, alongside and mixed with them, being comparatively uninjured. I have 500 dwarf Duchess pears. These were injured next in extent to the Bartlett's."—W. F. W. FISHER.

The pear slug is not a difficult insect to control. Spraying with a weak solution of Paris green or dusting with freshly slaked lime or Paris green diluted with 50 times its weight of some dry powder, are always effective.

THE GRAY PEACH WEEVIL (*Anametis grisea*, Horn) has been again reported this year as a troublesome peach pest. I referred to it in my last report as having injured apple trees in the orchard of Major R. F. Rogers at Grafton, Ont. This year, I am glad to learn that it has given no trouble in that orchard. It has appeared at Queenston, Ont., in the orchard of Mr. C. E. Fisher, but has done very little damage. The following record, however, which was brought to my notice by Mr. L. Woolverton, is of a more serious nature:

"Fenwick, Ont., April 25.—I write to you in the hope that you may be able to suggest a remedy for this beetle, which has proved very destructive to my young peach trees. Last year we tried picking the insects, but notwithstanding our efforts, they killed many of my trees, and are beginning this year again. The trees are just from the nursery, so there is almost nothing to spray. The beetles eat the young bud as soon as it appears, till they finally kill the tree. They seem to prefer the peach but also attack the pear and plum."

"May 21.—I send you some of the beetles you ask for. It has not been very suitable weather for finding them, as they come out best on warm sunny days. They are not as troublesome in my orchard this year as last, but seem to have gone to other orchards. Last year, they killed 130 young peach trees for me, and ate out four rows of strawberries extending across a six-acre field. They only attack the very first leaf buds and the bark of the young trees when first set out, or when a young tree is budded and cut off near the ground; then by eating the bud they destroy the tree. In many of their habits they resemble the potato beetle, such as dropping to the ground and

THE PEAR SLUG (*Eriocampa cerasi*, Peck, Fig. 8.) has been the cause of much injury to pear, plum and cherry trees. Mr. G. W. Henry, the well known nurseryman, of Hatzic, B. C., writes:—"Pear and cherry trees suffered badly from slugs last season; I sprayed with Paris green, which killed the slugs, but also injured many of my young trees badly, though I used at the rate of 300 gallons of

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hollowed out; and were particularly injurious, in the same way as *Prospila*, Walker, on S. Freeman, of Freedmen, of my Bartlett's by N. S., complained of them as injuring the tree.

Ampera cerasi, Peck, of much injury to trees. Mr. G. W. Fryman, of Hatzic, cherry trees suffer from it; I sprayed the slugs, but young trees badly, of 300 gallons of lime, the danger of which will be adopted for the use of fresh lime.

Burlington, Ont. which are Bartlett's. The substance is applied. After an examination from end to end, mixed with them, these were injured.

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reported this year of injured apple trees, I am glad to hear, Queenston, Ont., The following is of a more

may be able to protect young peach trees. Our efforts, they are just from the young bud as the peach but

not been very common. They have gone to other parts of the country. The very first leaf of the tree is budded. In many cases the ground and

lying apparently dead. On warm sunny days they move about and eat, and on cold or wet days, they lie concealed at the root of the tree in the earth."—E. S. ATKINS.

These beetles being wingless, they can only reach the buds of the trees by climbing up the stems; therefore, any mechanical means of preventing this, such as a band of cotton batting, or one of the many kinds of "tree protectors," placed around the trunks at the time the mature beetles appear in April and May, would be a sufficient remedy.

THE PEAR LEAF BLISTER (*Phytoptus* (*Typhlodromus*) *pyri*, Sheuten).—This troublesome pest of the pear is becoming much more widespread in Canada. Specimens have been sent in from several localities in the east as well as from British Columbia. Mr. L. Woolverton says:—"The Pear leaf Blister mite is gaining ground on the pear trees in this district, and, so far as I know, growers have done nothing to check it. Some trees have their leaves full of it." Among several communications from British Columbia, I received one from Mr. T. A. Sharpe, giving an excellent description of the appearance of the injury:

"Agassiz, B. C., July 6.—I send pear leaves which appear to be affected with reddish brown spots on under side, but showing very plainly on the surface. Under the microscope, the under side of the leaf is burrowed and raised into hummocks with craters or openings on the crest. A small insect, not visible to the naked eye, appears to be more or less plentiful on the leaves. Are these insects the cause or are they a secondary injury coming on after the fungus sets in? In any case, what is the remedy?"

Mr. Sharpe then gives an account of several experiments he tried with various mixtures to find a remedy. During the season he has studied this attack with care and has found in the galls another mite (a *Tyroglyphus*) which moves much more quickly than the *Phytoptus*; but he has not yet been able to detect whether or not it is predaceous on the blister mites. The remedy for this pest which has given the best results, is spraying the trees early in spring with Kerosene emulsion.

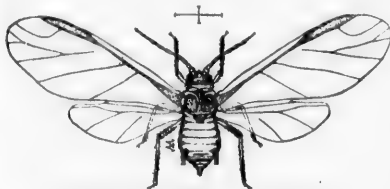


Fig. 9.—Apple Aphis: winged female.

The Apple Aphis or green fly is a common insect wherever the apple is grown, and although frequently very abundant, it is seldom that its injuries to its host are of a

serious nature in this part of Canada. From British Columbia, however, there have been received during the past three or four years many complaints of great losses from this pest,—particularly since the publication of the excellent reports of Mr. J. R. Anderson, the energetic statistician of the Provincial Department of Agriculture, have shown the fruit growers of that province that useful information can, on application, be obtained as to the best means of fighting their insect foes. From late correspondence with some of the leading fruit growers, it has occurred to me that part of the damage to apple trees complained of under the name of "aphis," "green fly," &c., may have been due to other insects. That the climate of British Columbia is particularly well suited to the development of many species of plant-lice, however, is undoubtedly the case, as I observed in the summer of 1883 and during the spring of 1885, and it is important that as soon as possible the different species should

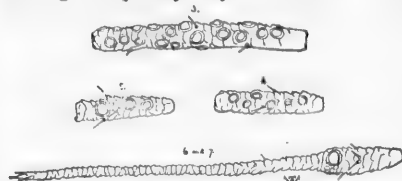


Fig. 10. Joints of antenna of Apple Aphis winged female.

be studied critically and their life histories worked out, so that the most suitable remedies for those which injure crops may be made known and applied at the proper time. As a contribution towards this knowledge, I am pleased to be able to present herewith careful enlarged drawings of the Apple Aphis (*A. mali*) and of the joints 3, 4, 5, 6 and 7 of its antenna (Fig. 10), made by my esteemed correspondent, Prof. H. T. Williams, of the South Dakota Agricultural College, who has made a special study of the Aphididae. This, I believe, will be of great assistance to British Columbian fruit-growers in identifying the species.

It is not only in its attack on the apple tree that the Apple aphis levies toll from the farmer, for it is now known to be a serious enemy of fall wheat.

Prof. Riley in his report, as United States Entomologist for 1889 (p. 351), when treating of the Grain Aphis, says: "Observations are complicated by the fact that several other species of plant-lice are found in greater or less numbers upon wheat. The common Apple plant-louse (*Aphis mali*, L.) is often found on wheat after the appearance of the winged generation upon apple, and, indeed it is a question whether this species, in view of what we know of its summer migration, should really be known as the Apple plant-louse, any more than the Hop plant-louse should be called the Plum plant-louse."

Again Prof. F. M. Webster, of Ohio, in a paper on the "Insect Foes of American Cereal grains" (*Insect Life*, vol. VI, p. 152), writes:—

"It would appear almost visionary to advocate spraying apple orchards in mid-winter to protect the wheat crop; but nevertheless one of the most serious enemies of young fall wheat passes its egg stage on the twigs of the apple during the winter season. I refer to the Apple leaf-louse (*A. mali*, Fab.). Soon after the young wheat plants appear in the fall, the winged viviparous females of this species flock to the fields and, on these, give birth to their young, which at once make their way to the roots, where they continue reproduction, sapping the life from the young plants. On very fertile soils, this extraction of the sap from the roots has no very serious effect; but, where the soil is not rich, and especially if the weather is dry, this constant drain of vitality soon begins to tell on the plants. Though they are seldom killed outright, these infested plants cease to grow, and later take on a sickly look, and not until the aphis abandons them in autumn to return to the apple, do they show any amount of vigour."

In my last report, I referred to the complaints from British Columbia that many trees had been killed by the Apple Aphis. Commenting on this, Mr. E. Hutcherson, of Ladners, B.C., a good observer, and moreover one who knows well most of the injurious insects of his province, writes as follows:—"I compared aphids I sent you (true *Siphonophora avenae*.—J. F.) with those on apple and found them different. As regards the Apple aphis killing trees in this province, I do not know, I am sure, where you got your information; but I have failed to find a case in my experience, and I can assure you that it is not actually the case; they may have assisted the Bark blight and Woolly Aphis to some extent, as I have found that weak, poor growing varieties and those suffering from other diseases, are the trees most affected. My experience, in my own orchard, has been that a tree affected this year is almost sure to be free the following season. I cannot say that we have been troubled much with the Apple Aphis for the last two years. We have had rains and wet weather in the spring and early summer, and again early in September; for this reason, the aphids have not been so plentiful as formerly. In this matter I speak not only for my own district, but for the whole province, up to the end of 1893."

And in another letter Mr. Hutcherson reverts to the same subject:—"In speaking of the trees being killed by the Apple Aphis in the Okanagan country, I would say that in some of the orchards there I found trees badly affected with Scurfy Bark-louse, which with the aid of the green aphis had killed quite a few trees." With regard to the correct identification of the Scurfy Bark-louse in the above quotation, I have some doubts; but when I wrote for specimens to the owner of the orchard, I found that the trees had all been cut down and destroyed.

Remedy.—The most satisfactory remedy for the Apple Aphis I have found to be the Kerosene emulsion, which should be sprayed on the trees early in spring, just as the

most suitable remedy at the proper time. I present herewith figures 3, 4, 5, 6 and 7. H. T. Williams, of the Aphididae, growers in iden-

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351), when treatment is such that several heat. The complete appearance of this species, in which as the Apple plant-louse," of American

orchards in mid-winter season. Heat plants appear in the fields and, on the other hand, where they are in fertile soils, this is not the case. The soil is not soon begins to and plants cease to add them in

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buds are opening. As many eggs are frequently laid on the trunks, these latter should also be sprayed.

The Apple Aphis very much resembles superficially the Grain Aphis, and, as both occur together on fall wheat, I have asked Prof. Williams to prepare for me a simple table of the chief points by which they may be separated. He has very kindly sent me the following, which will answer all purposes:—

"*Aphis mali*."

1. Antennae shorter than body.
2. Antennae on very slight frontal tubercles.
3. Head pointed in front.
4. Eyes black.
5. Prothorax with lateral tubercles.
6. Head and thorax black.
7. Honey tubes not broadened at base.

Siphonophora avenae.

1. Antennae as long or longer than body.
2. Antennae borne on distinct frontal tubercles, which are approximate at base and of moderate size.
3. Head not pointed in front.
4. Eyes reddish.
5. Prothorax with no lateral tubercles.
6. Head and thorax brown.
7. Honey tubes broadened at base.

"There are, of course, other differences both generic and specific, such as the closely built body and shorter legs and honey tubes of *Aphis*, and more elongated body, longer and larger honey tubes and style of *Siphonophora*, as well as differences in wing characters; but those given above will, I think, serve to separate the insects readily."

THE CIGAR CASE-BEARER OF THE APPLE.

(*Coleophora Fletcherella*, Fernald.)

Attack.—Small orange-coloured caterpillars with black heads and dark feet, enclosed in brown leathery cigar-shaped cases which they carry about with them. They attack the leaves of apple, pear and plum trees, by eating a small hole through the epidermis, and then feeding on the parenchyma or soft substance of the leaf, which lies between the upper and lower surfaces, protruding their bodies a long way out of the cases, and eating for some distance around the central hole. When they have consumed all they can reach, they move to a fresh place and make another hole. The brown case is very tough and at the upper end is contracted abruptly into a three-limbed star-shaped orifice, the lips of which fit closely together. Through this hole the excrement is ejected and ultimately the moth makes its exit. The larvæ and the slender dark brown chrysalids are about four millimetres in length; the case is six millimetres. There is only one brood in the season. The small shining steel-gray moths appear at the end of July and the beginning of August, and lay eggs from which the caterpillars hatch the same season and make about one fourth of their growth before winter sets in.

The young larvæ hatch about a fortnight after the eggs are laid, and, burrowing into the leaf, feed upon the cellular portion for a short time. They then cut clean holes through the leaves by taking oval-shaped pieces of the epidermis from both surfaces of the leaf above and below, and with these they form their curious cases by joining them along the edges. The two surfaces of the leaves are easily recognizable on the cases, from the pubescence of that side which was taken from the lower surface. The cases made by the larvæ in the autumn are quite different in shape from those of the full-grown larvæ which are found on the leaves in June. The autumn cases in which the winter is passed, are curved or elongated kidney-shaped, with a narrow wing in the curve. These are retained for a short time in spring, and are enlarged by the addition of small pieces of epidermis attached to the orifice. Occasionally, a larva leaves an old case on reviving in spring, and forms a new one at once; but, as a rule, the old case is detached from its winter resting place, and used for some time.

The summer cases are cylindrical, tapering slightly to the ends, in fact, very much like a miniature cigar in shape.

The following is Professor Fernald's technical description of the insect, which appears in the Canadian Entomologist, 1892, page 122 :—

"*Coleophora fletcherella*, Fernald—Expanse of wing from 10 to 12 mm.; head, palpi and basal joints of the antennæ, yellowish steel gray; body, legs and wings above and beneath, plain steel gray, much more intense in fresh specimens.

"The palpi are without tufts, the basal joints of the antennæ with a slight tuft, and the remaining joints of the antennæ and also the joints of the tarsi are steel gray annulated with white.

"The cases are brown, composed of a portion of leaf, cylindrical or fusiform, slightly compressed laterally, and with a more or less distinct ridge above and beneath. The mouth is more or less oblique, with the edge flaring out slightly. One side of the case is covered with fine hairs the other is smooth, showing that the larva constructs its case from the upper and under sides of the leaf.

"Described from three specimens received from Mr. James Fletcher, for whom I name the species, and who bred it from apple. I have also received the same species from Prof. Lintner, who also bred it from apple."

This insect has been treated of in previous reports of this department (1891, pages 196-198; and 1892, page 146).

During the past summer this small but destructive enemy of the apple has been reported to me as injuriously abundant in Ontario, at Oshawa, Maitland and Grimsby, and in Canadian Horticulturist, 1894, page 302, without locality, in Ontario; and in Nova Scotia, at Lakeville and Woodville. It has also been noticed in small numbers at several places in Ontario, Quebec and the Maritime Provinces. It has shown itself to be very difficult to treat; but it is probable, from Dr. Young's experience cited below with other correspondence, that spraying with Kerosene emulsion and Paris green early in spring is an effective remedy if persevered in.

The following extracts from some of the letters received will be found instructive and useful :—

"Oshawa, Ont., March 30.—Inclosed you will find two small apple twigs. What is on them? Will you write me and let me know how to destroy them? I have about forty acres of apple orchard and these things are getting very numerous, as you can see by the twigs. As quick as the bud opens in the spring, they crawl out on the young leaves, and, when full grown, are about as big as a kernel of rye."

"April 19.—I am glad to know the name of the little pest that is injuring my apple trees, for I think they are hurting the trees considerably. I first noticed them two years ago. They were not so bad as they were last year, taking the orchard all through.

"I sprayed a part of the orchard two years ago with Paris green, 4 ounces; sulphate of copper, 4 pounds; lime, 4 pounds; water, 50 gallons. I sprayed for the Codling Moth and Black Spot on apple when the apples were about as big as small cherries. Last year, I sprayed all the orchard but about five acres. The trees on these five acres are about twelve years old, about half Northern Spys and Ribston Pippins. The Ribstons are very bad; the insects are about fifty on the unsprayed trees to one where I sprayed; but the Northern Spys are not much worse than where I sprayed. How much they are hurting the trees, I cannot tell,—if I went by the fruit, I would say a good deal. Two years ago, I had 1,800 barrels of packing apples; last year, 375 barrels; but I am in hopes the Paris green is going to keep them in check."

"June 14.—I now write you my further experience with the Cigar Case-bearer. I sprayed as you recommended as soon as I could. I started on May 7th and sprayed for four days, a part of the orchard with duane Bordeaux mixture and a part with Paris green alone. I cannot see any difference. I seem to have killed about half or two-thirds of the insects. I believe I should have killed more, but the wind was blowing very hard when I sprayed, and the next week that big rainstorm came. I intended to write before, but was waiting to be sure of the effects of the spraying. The dead caterpillars still stick on the trees; but the live ones have grown away from the dead ones, so we can tell them now. I am going to spray again in a few days. I thank you very much for the trouble you have taken. When I wrote you first, on the 19th April, I was about discouraged. I did not think the Paris green would kill them. In previous

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years I did not spray until about the 20th June; the insects were then full grown, and I did not know when I had killed them, for they still stuck on the trees."—EDWIN WORDEN.

Fearing that Mr. Worden might have been deceived by the inactivity of the larvae owing to some of them having completed their growth and fastened their cases to the leaves in order to pupate, I wrote to him again, asking him to send me some of the leaves bearing the larvae which were supposed to be killed. These specimens were sent forward by Mr. Worden on June 19th, when he wrote:—

"I inclose you the leaves as directed by you. The little pest is hard to conquer. I am spraying again now. If these insects would leave my trees alone, I am satisfied I should have a good crop of apples, but they are even eating the little apples now."

Upon examining the specimens carefully, it was found that only 17 per cent of the larvae were dead, which was a disappointment, as it indicated that Paris green as a remedy was only partially successful. Mr. Worden was then requested to spray some of his trees with Kerosene emulsion. His answer was as follows:—

"July 5.—Inclosed you will find some leaves sprayed with Kerosene emulsion about ten days ago. It does not seem to do much good. I am about discouraged. These little insects seem to be getting worse all the time. Will you write and let me know about how long these insects troubled them in Prince Edward Island? If they are the same you mentioned in your report for 1891, I notice you say they were on plum and pear trees. Now, I have plum and pear trees side by side with the apple trees, and I never saw one on a plum or pear leaf. How would you think it would answer to have torches burning here and there through the orchard about the first of August? I noticed last year about the first of August, if the door or window was open after the lights were lit, the room would be full of little moths. Please write and give me your opinion of the torches and how far apart to have them in the orchard. I am willing to try anything you suggest to get rid of these insects, for I am satisfied the orchard will not do anything while they are on the trees."

Reply:—"July 20.—I was absent from Ottawa when your letter arrived and have just returned. By this time the case-bearers will have stopped their work upon your apple trees. Dr. Young, of Aldolphustown, who suffered very severely a year or two ago from this same pest, treated it very successfully with Paris green and Kerosene emulsion. My correspondent, the late Mr. Wm. Brown, of Charlottetown, Prince Edward Island, only had this pest on his trees two years; his attack was upon plum trees. As you have noted, it is a very remarkable thing how the same insect will attack one kind of plant in one district and another somewhere else. An analogous instance is the 'Shot-borer' beetle of Nova Scotia, which there attacks the apple tree almost exclusively; while in England the only reported attack by it, is on plum, and, at the same time, the first attack noticed by this insect was upon pear trees, hence one of its names—the Pear-blight beetle.

"It is just possible that your suggestion of carrying torches through the orchard when the moths appear may be a valuable one, and I shall be very much obliged if you will try it. The moths are just appearing from the caterpillars which you sent me early in the season, so that now would be the proper time to test this remedy. A convenient way of destroying them in large numbers, if you find that they are attracted by the light, will be to place in the orchard a lantern or lamp in a basin of water, having first sprinkled a little coal oil on the top of the water. The moths flying to the light will fall into the water and be destroyed by the film of coal oil which floats on the surface. I shall be much obliged if you will try this remedy and let me know how it succeeds."

From the following reply, it will be seen that the use of a light at night to attract the moths was not very successful:—"I tried the torch light on a small scale. I had to cross the road from my house to the orchard, and, strange to say, while on the road, the moths would come very thick; but when I got in the orchard, I did not catch so many all night by leaving the torch burning, as I did during the few minutes outside. I think I destroyed about half of the case bearers with the treatment last summer. Next year I am going to try the Kerosene emulsion, but would like to spray a little later than the time you suggest so as to catch the bark louse as well."—EDWIN WORDEN.

Careful investigations were also made on this insect at Maitland, Ont., by Mr. Harold Jones, who has kindly supplied me with much valuable definite information on its life history. Mr. Jones called upon me on August 24th, and spoke of the case-bearer as having been very abundant in his orchard this year. He first noticed it early in the spring, attacking the buds and the stems of the flowers and leaves. He sprayed at once before the flowers opened. Directly the flowers dropped, he sprayed again with Bordeaux mixture and thinks that 25 per cent of the larvæ were destroyed. He sprayed a third time about three weeks later when the apples were about as large as a pigeon's egg. He observed that, about the third week in June, the larvæ ceased feeding and went to the upper surface of the leaves to pupate. On September, Mr. Jones sent me a supply of the young larvæ with the following letter:—

"Maitland, Ont., September 1.—Referring to our conversation of a week ago, I send you by this mail twigs of apple, with the case-bearers attached. You will note that, whereas three weeks ago the young caterpillars were on the underside of the leaves, now you will find them clustered about the buds, attached to the bark of the present year's growth in every case. They are now about double the size they were on the 10th August when I first observed them. I picked out the worst affected twigs that I could find, for I thought you would be glad to note their habit of clustering."

Later Mr. Jones sent the following interesting résumé of his observations:—

"November 6.—Referring to our conversation of August last and our correspondence during the early part of September, relating to the actions and life of the Cigar-shaped Case-bearer; I now give you the result of my observations during the season, hoping that there may be some point that may aid you in finding the best time of the season to most effectually destroy this serious pest to our apple orchards.

"During the early part of May, just as the buds were opening, I sprayed my trees with Bordeaux mixture; and a short time after, when the blossoms opened, I noticed that the half-opened leaves and flowers withered and died. I had no idea of the cause at first, but on examination, I found large numbers of a strange insect (since known as the Case-bearer), had punctured the stems of the leaves and flowers and were working so rapidly that, when the blossoms fell and I was able to spray again, some of the trees had very little set fruit left.

"This second spraying was done with Bordeaux mixture and Paris green in the proportion of one pound to 200 galls. of mixture. The results of this application were hard to determine, but I noticed that all further attacks on the young fruit were stopped and the caterpillars were working on the underside of the leaf, whereas before they worked on both sides.

"I think I am safe in estimating 20 or 25 per cent destroyed. I sprayed again with the same mixture and Paris green added, about two weeks afterwards when the apples were about the size of the top of my thumb or larger, this making three applications in all. The last application did not affect them perceptibly, as at that time they had permanently attached themselves to the leaf to go into the pupal state.

"About the 10th of August I first noticed the young brood feeding, they were then so small as to be hardly noticeable, and were less numerous, there being only about one-fifth of their numbers in the spring. During the next 20 or 25 days, they fed and grew to a length of about $\frac{1}{8}$ of an inch or more. At that time, the first week in September, the weather turned quite cool and they left the leaves and clustered in rings about the base of the present year's wood growth.

"From that date until the middle of October, they could be found either on the leaf feeding, or attached to the twig according as the weather was warm or cold. After the middle of October, they left the foliage and twigs and are now attached to the larger parts of the tree, in some cases down on the trunk, but mostly on the under side of the branches at their junction with the trunk or larger branches, and I also find clusters of them in the shelter formed by a partly healed wound where a limb has been severed.

"This is winter during the most severe weather, I intend taking a stiff brush and brushing some of the trees in all the crotches and larger branches and letting the insects fall on the snow, where I am in hopes they will perish.

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"If my theory, that frost and snow will destroy these insects, prove correct, I can quickly and easily remove one-half to three-fourths of the entire brood now lodged on trees eight or ten years of age, and diminish their numbers on larger trees."—HAROLD JONES.

"Lakeville, N. S., June 8.—I inclose to you to-day some specimens of insect pests for examination. The insect attacks the young buds and leaves, destroying the foliage as soon as it appears. The Baldwin, Tompkins, Twenty-ounce Pippin, Talman Sweet and Rhode Island Greening, were attacked and the young leaves almost entirely destroyed, while the Bishop Pippin (Yellow Belle flower) tree was almost entirely free from the pest. I sprayed before blooming with Paris green 4 ounces, lime 3 lbs., water 45 gallons. I could not see that any insects were killed, being just as numerous after spraying. Any information you can give me about destroying this insect, will be thankfully received."

"June 20.—I send you specimens of the insects that have been doing very much damage to fruit trees in this locality this spring. They began their work of destruction about 1st May, when a few were seen to crawl from the angles of the small branches and attach themselves to the leaves just beginning to form. They would move along the branches, the head protruding from the sack or cigar-shaped case. About May 10th I sprayed the trees from which these specimens were taken on June 20th, with Paris green 1 lb., lime 4 lbs., water 160 gallons. At that time only a few were on the foliage. The greater part of the pests were still to be found in the angles of the small branches and rough places of the bark. The application of this mixture destroyed very few, if any. To-day, June 20th, I notice some time after full bloom the blossoms withering and dropping from the tree at the slightest jar from the hand, and the foliage of the tree having the appearance of being riddled with small shot and scorched by heat. On these trees no fruit is forming, although the blossoms looked healthy."—R. A. BECKWITH.

At the end of the season, Mr. Beckwith reported as follows :—"I did not spray as you advised. By July 1, nearly, or quite all of the insects had disappeared, the trees soon after having a healthy appearance. A few orchards only were damaged by this insect in this section of the valley." (Lakeville is in the Annapolis Valley, so celebrated for its fruit.) "Those orchards in which the case-bearer appeared were badly damaged, the crop a total failure."

"Woodville, N. S., March 28.—I send you to-day some apple limbs. You will find on them small insects which have done a great deal of damage in this county. Please explain their habits and send a remedy."

"April 18.—Thanks for information. I am sending you more specimens to-day out of the same orchard.

"These insects destroy the buds, as you see by specimens; destroying the buds injures the crop, as new buds have to start. The insects are now commencing to crawl on to the buds, destroying first the buds, then the blossoms, if any are left, and leaves; so you see something must be done before the trees blossom. They seem to work on some varieties more than on others. The variety sent is Nonpareil. The trees look, at the end of June and in July, when the trees are leafing out and blossoming, as if they had been scorched by fire.

"We consider this little caterpillar the worst enemy to our fruit crop. Please advise me what to do, as the remedy must be applied at once."—G. W. F. McLEAN.

Remedies.—As a remedy we at first recommended spraying with Kerosene emulsion during the winter, to destroy the hibernating larvæ, but it appeared to have no effect. Twigs from sprayed trees were sent to me in winter by Dr. Young, which, a fortnight after spraying, still retained strongly the odour of Kerosene (coal oil); when revived by the warmth of my office, the larvæ crawled about uninjured, and Dr. Young reported that these trees treated in winter showed no benefit from the spraying.

Spraying with Kerosene emulsion and Paris green at the time when the buds are opening, has given the best results, as will be seen from the following letters :—

"Adolphustown, Ont., June 26.—On the large block of Duchess apple trees, where we sprayed in 1891 and 1892, where the said worms were so numerous, there is only an odd worm to be seen. But in other parts of the orchard, where they had scarcely

reached at first, they were numerous this spring. We sprayed them with Paris green, but on account of weather, and my brother's illness, the spraying was not complete, nor as effective as one would wish.

"July 3.—The Kerosene emulsion, either warm or cold, used in the winter, had no effect. But when used cold in the spring, after the worms began to move about, was very effectual. It more completely cleaned the trees of the Case-bearers than did the Paris green. Still the Paris green did well and took most of them off. We sprayed with both the same day. We sprayed the next year again with Paris green, and this year again, but this year there were very few indeed in that part of the orchard."—Dr. D. Young.

From the above it would appear that, owing to the fact that the caterpillars for the most part feed beneath the leaves and eat very little of the outer surface, Paris green, although effective in a certain measure, is not a satisfactory means of controlling the Cigar Case-bearer. The best remedy in our experience so far, is Kerosene emulsion applied as a spray when the young larvæ are active, particularly early in spring.

THE SAN JOSE SCALE.

(*Aspidiotus perniciosus*, Comstock.)

Few insects which attack fruit trees are with more reason dreaded by the horticulturist than the San José or Pernicious Scale of the Pacific Coast. On two or three occasions it has been reported to me as occurring in British Columbia; but I had at first the impression that the insect referred to was the Scurfy Bark-louse (*Chionaspis furfur*, Fitch), or something else. During the past summer, however, undoubted specimens of *Aspidiotus perniciosus* on apple have been received from British Columbia and have been identified by Mr. L. O. Howard. From recent correspondence, I believe it is probable that, at any rate, some of the serious injury to the apple trees in British Columbia which has been reported as due to the Apple Aphis is in reality caused by this and other scale insects. The fact that one is a plant-louse with well developed organs of locomotion at all stages after hatching, and the other a scale insect, which has the power to move for only two or three days, does not affect this supposition; for, unfortunately, there is even yet a most deplorable ignorance and indifference as to the right names of the worst insect enemies of the farmer and fruit-grower. So that the referring a pest even to the right natural order is the exception rather than the rule, "bugs," "flies," "weevils," "grubs" and "worms" being accused indiscriminately of injuries caused by quite different insects. Not only does this cause loss of time, because, in many instances, specimens have to be written for; but in those cases where cultivators undertake to doctor their crops themselves, the wrong remedy is often applied, of course, to their great disappointment at obtaining no beneficial results. In all cases, whenever possible, specimens should be sent with letters of inquiry.

Knowing the great danger which would result from the failure on the part of Canadian fruit-growers to recognize and use every effort to eradicate so pernicious a foe as the San José Scale, as soon as it was known for certain that specimens had occurred in Canada, I prepared for *The Farmer's Advocate*, of London, Ont., which has a wide circulation, and for the *Annual Report of the Entomological Society of Ontario*, an article giving the life history and the remedies which had been found most effective against this pest. These were drawn for the most part from the records of the warfare waged by the United States Division of Entomology, which have been kindly supplied to me by Mr. L. O. Howard, who has also been good enough to lend me the four figures used to illustrate this article.

I reproduce herewith extracts from these articles so as to bring the proper treatment to the knowledge and attention of as many as possible.

This insect has had attention drawn to it of late by its unexpected appearance in injurious numbers in the Eastern States during the summer of 1893, and the Division of Entomology at Washington, under the direction of the United States Entomologist, Mr. L. O. Howard, has, during the past summer, adopted such vigorous measures to combat it, that there is reason to hope that in all the localities from which it has been reported, the insect has either been eradicated or brought under control.

Up to 1892, the San José Scale was thought to be confined in North America to the Pacific States, where it has shown itself to be a most destructive enemy of the fruit grower. It was probably first brought to California on fruit trees imported from Chili about 1870, and the name, San José Scale, was given to it by fruit shippers in 1873, from the name of the place in California where it was first noticed. It spread rapidly for seven years without any particular attention being paid to it. In 1880, however, Prof. Comstock pointed out the great loss which it was causing, and gave it the specific name *perniciosus*, for the reason that he considered it to be the most pernicious scale insect known in the country. It not only swarmed in countless numbers on fruit trees in certain orchards, but infested nearly all kinds of deciduous fruit trees grown in California. In a special circular which Mr. Howard issued last year, when the insect appeared in the States of Virginia and Maryland, he says as follows: "In the course of twelve years, the insect spread through all the fruit-growing regions of California, through Oregon and into the State of Washington."

It is known as the worst insect pest of deciduous fruit trees on the Pacific coast, and has caused great pecuniary loss. Many crops of fruit have been ruined, and thousands of trees have been killed. (L. O. Howard, *Circular No. 3*.)

In 1892 the insect was found in New Mexico on apple, pear, plum, peach, quince and rose. It had been brought into New Mexico upon young trees from California. Nearly all the other instances of infestation east of the Rocky Mountains can be traced to two nurseries in New Jersey, where the pest had been introduced in 1886 or 1887 on trees of the Japanese plum "Kelsey," which had been procured from the San José district in California. Idaho pear trees had also been frequently imported from California, which were most probably infested. In 1891 and 1892 several blocks of young apple trees were badly infested. It is on pear trees chiefly that this pernicious scale has been distributed through the State of New Jersey. Prof. J. B. Smith says (*Insect Life*, VII., p. 166):—"The Idaho pear has been the most dangerous because it came infested whenever imported direct, and after it, came in close order, Madame von Siebold, Garber, Lawson, Seckel, Lawrence and Bartlett. Other varieties are also infested, but less frequently, and the scales do not do so well. Kieffers alone are absolutely exempt, and closely following comes the Leconte, which is rarely infested in the nursery, and never in the orchard, in my experience. One tree grafted with Lawson and Kieffer had the Lawson branch and fruit covered with scales, while the Kieffer branch was entirely free. Currants, black and red, became rapidly infested and the scales were certainly distributed on these plants."

Mr. Howard says that this insect spreads rapidly for a scale insect, and is the most dangerous scale known. It is, too, inconspicuous and would be overlooked by many. Specimens of apple boughs received from British Columbia were entirely incrustated with the scales, so as to give them the appearance of having been dusted with ashes. Mr. Howard gives the following description of the scale in his circular above referred to: "The San José Scale belongs to the same group of scale insects, the Diaspinæ or armoured scales, to which the Oyster-shell Bark-louse of the Apple belongs. It differs from this species, and in fact from all other eastern species found on deciduous fruit trees, in that the scale is perfectly round, or, at most, very slightly elongated or irregular. (Fig. 11). It is flat, pressed close to the bark, resembles the bark of the twigs in colour, and when fully grown is between $\frac{1}{16}$ and $\frac{1}{8}$ of an inch in diameter. At or near the middle of each scale is a small, round, slightly elongated black point; or this point may sometimes appear yellowish. When occur-

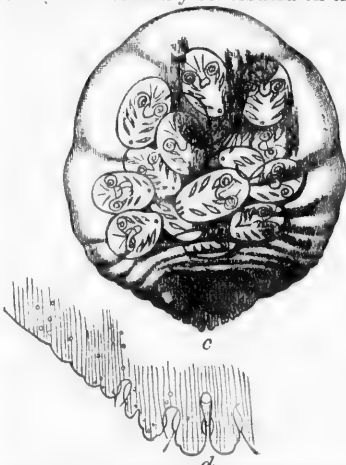


Fig. 11.—San José Scale: *a*, adult female containing young, greatly enlarged; *b*, anal fringe of same, still more enlarged.

ring upon the bark of the twigs or leaves and in large numbers, the scales lie close to each other, frequently overlapping, and are at such times difficult to distinguish without a magnifying glass. The general appearance which they present is of a grayish, very slightly roughened scurfy deposit." (Fig. 12.)

The natural rich reddish colour of the limbs of the peach and apple is quite obscured when these trees are thickly infested, and they have then every appearance of being coated with lime or ashes. When the scales are crushed by scraping, a yellowish oily liquid will appear, resulting from the crushing of the soft yellow insects beneath the scales, and this will at once indicate to one who is not familiar with their appearance, the existence of healthy, living scales on the trees. During winter the insect is to be found in the half grown, or nearly full grown condition. The young begin to hatch and to crawl from under the female scales shortly after the trees leaf out, and from this time through the summer there is a constant succession of generations. The insect affects not only the young twigs and limbs and, with young trees, the entire plant, but is also found upon the leaves and upon the fruit. When it is abundant, the fruit is destroyed. One of the most characteristic points in the appearance of the insect upon fruit is the purple discoloration around the edge of each scale.



Fig. 12.—San José Scale: Apple branch with scales; large scales above at left.

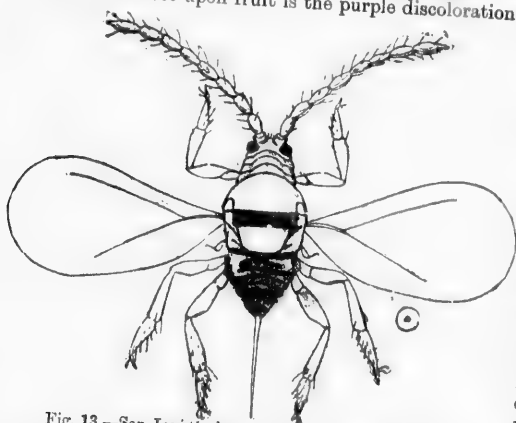


Fig. 13.—San José Scale: male adult, greatly enlarged.

in fighting the San José Scale. In cases of severe attack, it is recommended to cut down the infested trees and burn them. The other methods are: Spraying with insecticidal washes or fumigating the trees with poisonous gasses. The insecticidal washes may be divided into summer washes, which can be applied while the trees are in leaf, and winter washes of a stronger nature which would injure the foliage, but will do no harm to the trees during the winter when these are in a dormant condition, and yet will have the effect of destroying the scale insect. Of the *summer washes*, the ordinary Kerosene emulsion (Riley-Hubbard formula) and a Resin wash [Resin 20 lbs., caustic soda (70 per cent strength) 5 lbs., fish oil 3 pints, water 100 gallons], were recommended by Mr. Howard, and used with success during the past summer. On peach trees, owing to the susceptibility of the foliage to injury, the stock emulsion was diluted with fifteen times its volume of water, instead of nine times, the usual strength advised

Fig. 14 shows a pear attacked by the scale and a separate scale much enlarged. The male is an active minute insect. (Fig. 13).

The above description and figures will enable fruit-growers to recognize this enemy should they be unfortunate enough to get their orchards infested with it. With regard to remedies, we have the advantage of all the experience of Californian experimenters, the careful work of the Division of Entomology at Washington, and of Prof. J. B. Smith, of New Jersey, during the past year. There are three methods which have proved effective

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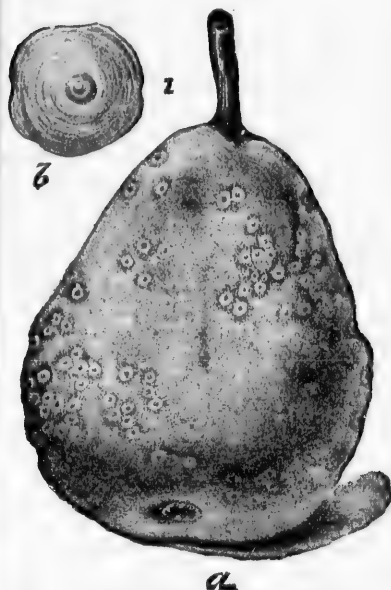


Fig. 14.—San José Scale; *a*, pear moderately infested; *b*, female scale enlarged.

for most other plants. It was found advisable to repeat the sprayings at intervals of about a week. The young scale insects were noticed on May 19th at Riverside, Ind., and the females, viviparous in habit, gave birth to young for a full month. This was upon peach trees, and it was found that the Resin wash killed the scales more quickly than the very much diluted Kerosene emulsion. As Mr. Howard points out, this rapidity of the work is important, since where a full grown female is sprayed with Kerosene emulsion, she may live for three or four days, during which time she brings forth young; whereas if sprayed with Resin wash, fewer young scales are produced. The resin wash, however, is readily carried off by the rains, while the Kerosene emulsion is more resistant.

In Prof. J. B. Smith's investigations in Pennsylvania, it is recorded in *Insect Life* (VII., p. 159) that "he has visited the locality at Atglen, Pa., and found that in an orchard of over 7,000 trees, all of certain varieties, and a few of others were infested by the scale. As a result of his recommendations, Kerosene emulsion has been applied three times to most of the trees at intervals of ten days, up to the first week in June. The treatment has been absolutely successful."

For winter washes, the Kerosene emulsion and Resin washes may be made stronger. The stock Kerosene emulsion has been used diluted with only $4\frac{1}{2}$ parts of water, and for the Resin wash the same ingredients were used in the following proportions: Resin, 30 lbs., caustic soda, 9 lbs., fish oil, $4\frac{1}{2}$ pints, water, 100 gallons.

"The most favoured winter remedy in California, however, is the lime, salt, and sulphur mixture. This consists of unslaked lime 10 lbs., sulphur 5 lbs., stock salt 5 lbs., water to make 15 gallons. This wash will do great damage to the trees if applied during the growing season, and should be used only in winter. All the sulphur and half the lime are placed in a kettle, and $8\frac{1}{2}$ gallons of water added; after which, the contents of the kettle are boiled briskly for about an hour. The solution, which at first is yellow from the sulphur, will turn very dark brown, assuming more or less of a reddish tint, and will finally change from a thick batter to a thoroughly liquid condition, the product being ordinary sulphide of lime. All the salt is added to the remaining 5 pounds of lime, and the latter slaked; after which, the slaked lime and salt are added to the sulphide of lime already obtained, the whole being then diluted with water to make 15 gallons. This should be strained before application, as it does not form a perfect liquid solution, on account of the considerable quantity of undissolved lime, which will soon sink to the bottom, unless the solution is constantly stirred while being sprayed." (L. O. Howard, *Circular No. 3*.)

The third method of fighting scale insects is known as the Gas Treatment. This has been extensively used in California, but is an expensive operation, and the materials necessary are very poisonous and dangerous to have about a house. It consists, briefly, of covering the tree to be treated with an air-tight tent, and then filling the tent with the poisonous fumes of hydrocyanic acid gas, which is generated by placing 1 oz. of cyanide of potassium, 1 fluid ounce of sulphuric acid and 3 fluid ounces of water in an earthenware vessel beneath the tent. The gas is very light and rises to the top of the tent, and if this be kept on the tree for half an hour, every scale will be destroyed. The quantities of ingredients given above are sufficient for a tent inclosing 150 cubic feet.

What is wanted, however, is to know the best remedy, and it is satisfactory to find that, on the whole, the standard remedy for scale insects, Kerosene emulsion, is the best. In summing up his experience of the year, Mr. Howard says as follows:—"Remedial work against this insect is onerous, but our experience has shown that three sprayings at intervals of ten days during the latter part of May and June, will practically destroy the insect, whether the spraying be conducted with very considerably diluted Kerosene emulsion or with a resin wash, while during the winter a single application of either of the three winter washes will greatly reduce the numbers of the insect. Among the winter washes, our experience leads us to give the preference to strong Kerosene emulsion; next, to the winter Resin wash; and finally, to the lime, salt, and sulphur mixture."

The Kerosene emulsion is now well known to most Canadian fruit growers; but it may be well to give its mode of preparation here.

Kerosene (Coal oil).....	2 gallons.
Common soap or Whale oil soap.....	$\frac{1}{2}$ pound.
Water.....	1 gallon.

Cut up the soap and boil in the water till all is dissolved; then add it boiling hot to the coal oil; churn the whole briskly for 5 minutes with a syringe or force pump. When the emulsion is perfect, it will adhere without oiliness to the surface of glass and when cooling it forms a jelly-like mass, which can be kept indefinitely, if stored in a cool place and covered from dust.

When required for use; for a summer wash, dilute 1 part of the stock made as above with 9 or 15 parts of water. To make the stock dissolve easily, take first 3 parts of hot water to one of the emulsion and then when all is thoroughly mixed, add the rest of the water to make the 9 or 15 parts required; for a winter wash, mix with $4\frac{1}{2}$ or 9 parts of water.

THE PEAR-TREE FLEA-LOUSE.

(*Psylla pyricola*, Förster, Fig. 15.)



Fig. 15.—The Pear-tree Flea-louse, enlarged.

Attack.—Small clear-winged insects, wedge shaped like miniature *Cicada*, the head being broad, flat in front, and the body pointed behind; one tenth of an inch in length, of a reddish brown colour with broad black bands across the abdomen. These insects, at the slightest disturbance, leap from the foliage of infested pear trees and fly for a short distance. Occurring with these, will be found on the leaves the curious flattened oval larvae (fig. 16), which, when first hatched, are very small, one-eightieth of an inch in length, of a semi-translucent yellow colour, with red eyes. These grow rapidly, and in about a month pass through five nymph stages, during which the body retains its flattened form and becomes much darker until, in the full grown nymph, the large wing-pads and the greater part of the upper surface are black. The eyes and sometimes the body between the black markings are crimson. The presence of this insect

upon trees is easily detected by the copious secretion of honey dew with which the leaves, limbs and trunks of the trees soon become covered and upon which a dirty-looking black fungus, *Fumago salicina*, develops. After a time, the leaves and young fruit fall, the trees assume an unhealthy appearance, and in the case of severe attack the tree dies.

Another enemy of fruit trees which has this year appeared for the first time in Canada, is the Pear-tree *Psylla* or Flea-louse, specimens of which were sent to me by Mr. J. S. Freeman, of Freeman, Ont., who writes:—

"Freeman, Halton Co., Ont., June 7.—I have a block of three hundred Dwarf Duchess pear trees mixed with apple trees, which are so badly infested with the insects which I am sending you, that, from the appearance

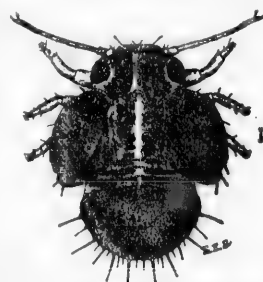


Fig. 16.—Nymph of Pear-tree Flea-louse enlarged.

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of Pear-tree Flea-
louse, enlarged.

of the trees at present, the whole crop, some of the worst specimens of which I am sending you, will be destroyed. I do not think the pear trees were troubled before this season. Would you kindly tell me what the insects are and give a remedy? Would it be too late to apply a remedy this season? Please reply.

Reply.—"June 8. Your letter of 7th inst., with insects inclosed, is just to hand and is of great interest. I wish you had written a little sooner in the season. The insects sent are the Pear-tree Psylla (*Psylla pyricola*), a pest which has done great injury in the States of New Jersey and New York. This is the first record of its appearance in Canada. It is a serious pest, and must be fought vigorously at once. The remedy is Coal-oil emulsion. (See page 12 of bulletin 11 sent herewith). Instead, however, of mixing the stock emulsion with nine times its quantity of water, I would suggest your using 12 times the quantity of water first, and see how that works. I shall be obliged if you will write me at once and let me know how long it is since you first noticed this pest, and if it is very prevalent in your district?

"The presence of this insect is always indicated by a sticky exudation noticeable on the twigs, called honey dew. Upon this, later in the season, a black fungous mould grows which gives the tree a very dirty and unsightly appearance. I cannot impress upon you too strongly the importance of treating this pest at once, and if possible checking its spread. Please let me know if you or any of your neighbours have recently imported trees from the States of New Jersey or New York. I shall be glad to give you any further information in my power."—J. F.

"Freeman, June 13.—I am much obliged for the information your letter brought me on the 11th inst. I have applied the coal-oil emulsion as you recommended on my Duchess Dwarf trees, which are 12 years old, in 12 times and not 9 of water as in formula; but besides being on these, I find the insects are more or less over my other pear trees of 9 acres of different varieties. I knew from the appearance of my trees that something unusual was attacking them; but I did not make a close examination of them until two days before I wrote you. This must be the first season this pest has been bothersome, or I should have noticed the fungous growth last season if it had been there as this. From inquiry of fruit-growers in this section, I think it is likely that this pest may be found in other orchards. The original trees in my orchard came some 15 years ago from Lockport, N.Y., and I have, with many of my neighbours, planted more or less pear trees every spring since, all the trees coming from the same place, Lockport. Any more information as to destroying this pest, will be gladly received."—J. S. FREEMAN.

Several articles have lately appeared upon the Pear-tree Flea-louse. By far the most complete study of the subject has been made by Mr. Mark V. Slingerland, of Cornell University, and the results of his labours have been published as *Bulletin 44* of the Cornell University Agricultural Station. In this a full history is given of the development and habits of the insect, illustrated by excellent figures, of which Nos. 15 and 16 have been kindly lent for this article. Winter is passed in the perfect state, the males and females hiding in crevices and beneath flakes of bark on the pear-trees. In the first warm days of spring, the date varying with the season, they emerge from their winter quarters, and after mating, "the eggs are laid in the creases of the bark or in old leaf scars, about the bases of the terminal buds of the preceding year's growth; some were seen about the side buds near the terminal ones. * * * * * The eggs are scarcely visible to the unaided eye. It would take eighty placed end to end to measure an inch. They are elongate, pyriform in shape, smooth and shiny, of a light orange yellow colour when first laid, becoming darker before hatching. A short stalk to the large end attaches the egg to the bark, and a long thread-like process projects from the smaller end. The temperature conditions in the spring influence not only the time of oviposition of this winter brood, but also the duration of the egg stage. The weather remaining cool, eggs upon the trees under natural conditions, did not hatch until May 10, or more than a month after oviposition began."

The young nymphs immediately on hatching, suck the sap. Mr. Slingerland found that a few nymphs emerged in spring before the leaves had expanded; these crawled into the buds out of sight. The favourite feeding places of the nymphs to

which their flat bodies adapt them, are in the axils of the leaf petioles and of the stems of the forming fruit. After the fifth moult, the adult insects appear; they are quite different in habits from the nymphs, being extremely active and flying away at the slightest disturbance. The winter form which lays the eggs of this first brood, is larger and brighter coloured than the summer broods, of which there are two or three.

The eggs of the summer broods are not laid "on the twigs, but on the under sides of the tenderest leaves, among the hairs near the mid rib, or on the petiole near the leaf. Sometimes the female very adroitly places an egg or two in each notch of the toothed edge of the leaf." The summer eggs hatch in eight or ten days.

Remedies.—As stated above, the Pear-tree Flea-louse hibernates in the perfect state on the trunks of the trees and begins to move about and mate early in the spring. At this time, the insects are not very active, and when it is known that trees are infested, many can be destroyed with small expense of labour and material by spraying the trees with Kerosene emulsion.

This will be more effective if the rough bark is first removed with a hoe or some similar instrument.

The treatment which is most highly recommended is to spray after most of the young nymphs have hatched. Mr. Slingerland says: "The best time to spray is early in the spring, just after the leaves have expanded. In 1892, about May the 15th, was the best time; then the first brood of nymphs had all emerged and were exposed in the axils. It was the first brood which did the most harm in 1891. Fruit growers should examine their orchards when the leaves are expanding, and, if the nymphs are numerous, the trees should be sprayed at once. A second and even a third spraying may be necessary. The destruction of the nymphs is practicable during a period of two weeks, about May the 15th. If the spraying is thoroughly done at this time, the pest will be so completely checked as to necessitate but little, if any, further attention during the season."

The Pear-tree Flea-louse belongs to the same class of insects as the Aphids or plant-lice, with which they form the second section of the *Homoptera*, known as *Dimera*, or those with two-jointed feet. In this section we find small insects with antennæ longer than the head and, in the winged individuals, four wings, ordinarily all of the same membranous texture. The Psyllidæ or flea-lice are small insects found on leaves, and some species, as the Hackberry Flea-louse, give rise to galls. They have long slender antennæ terminated by two bristles. The beak is short and tri-articulate, and the eyes are lateral and prominent as in the *Cicade*. In fact, these little flea-lice, although seldom much more than one line in length, very much resemble *Cicade* in miniature. On the front of the face are three ocelli placed in a triangle, the posterior ones quite close to the eyes. Unlike the Aphids or plant-lice, the flea-lice have the power of leaping, from which they take their English name.

THE PEACH BARK-BORER.

(*Phænotribus liminaris*, Harris.)

Attack.—Small cylindrical beetles, one-twelfth of an inch in length, of a brownish black colour, covered with short hairs, which bore in the bark of peach trees, and, if numerous, cause the death of the trees in three or four years. The presence of these beetles is easily recognized by the conspicuous red powder, which is the borings cast out of the holes by them in their mining work, and, in the winter and spring, by enormous quantities of gum which oozes from the infested trees, thus greatly reducing their vitality.

The Peach Bark-borer, although apparently a rare insect in Canada, is a serious pest in one or two orchards in Queenston, Ont.; I have as yet received myself no authentic record of its occurrence in other districts in Canada, although it is referred to by Dr. Lintner and Mr. Slingerland as having occurred in numbers at Ringwood, Ont.

With a view of bringing out further information as to the prevalence of this pest, and also to put on record what has been done towards finding a remedy and completing its life history, I submit herewith the following correspondence:—

"Queenston, Ont., March 22, 1893.—That small beetle borer which I gave you at the St. David's meeting has been seriously affecting my peach trees. I send you a few more. Will you please tell me about its habits and how to combat it? I wish to be positive as to the non-injury of the peach tree before using any wash. Some of my neighbours claim that they have nearly destroyed some of their peach trees by applying an alkali wash."—C. E. FISHER.

"Queenston, May 22, 1893.—I send you a piece of bark of a peach tree from my orchard, which is full of the little black beetles that we looked for last winter. The bark of this tree is all like the piece I send, and around the collar of the tree there is not less than a gallon of gum that has run out from the wounds made by this borer. Young trees do not seem to be attacked as much as older ones."—CAPT. JAMES SHEPPARD.

A remarkable feature of the attacks of this minute beetle upon the peach trees, is the large quantity of gum which oozes from the infested trees and falls to the ground. Upon wet days this swells up and lies in masses of jelly around the foot of the tree. I saw in several instances two or three quarts given off by a single tree. This must be a great injury to the trees and accounts for the short time in which healthy, vigorous trees are killed. The statement that only unhealthy trees are attacked is undoubtedly wrong. Mr. Fisher and I noticed in his orchard healthy young two, three and four-year old trees which the beetles had just begun to attack.

"Queenston, March 2.—With this I send box containing bark from peach tree which I had treated with strong lime and Kerosene emulsion wash twice during last season at intervals of about four weeks, for the Peach Bark-borer. I also send you in the box a small package of bark from a large English cherry tree about seven inches in diameter, which stands several hundreds of yards from my peach orchard and quite isolated from any elm or peach trees. The peach bark beetles have been at work in this tree, although they are not nearly so numerous as in the large peach trees. My reason for thinking that the lime and emulsion wash was not very successful was from the fact that, after it had been washed off by the weather, I saw fresh evidences of the borers' work in these trees, the fine chewed or ground bark standing out around the small holes made by the insects. I shall, however, be better able to judge this season as I have five or six trees specially selected to work with. I notice that the oldest trees are the ones selected by the borer, as I find occasionally an old tree in the orchard quite full of the little pest, though, where the insect first started his depredations, small trees only about 2½ or 3 inches in diameter and about four years old, have them in; but they do not seem to be nearly so numerous as in the old trees which have rough surfaces and cracks, where I suppose the insect can more easily secure a lodgement. I applied the wash first, I think, in June and then again in July, on a few others about the first week in August. The bark you have, is from a tree which had the two washes first mentioned. From examinations I have made, I am led to believe the borer does not burrow into the solid wood. To prove this I will saw off a section of a tree and mail it to you to-morrow, so you can prove positively whether or not it does. I shall try your advised experiment—the Kerosene emulsion put on with a scrubbing brush—though I have heard you could not injure a peach tree with scalding hot water.

"I shall try, as you suggest, pure kerosene on one tree. I might try the hot water on another and your emulsion on the balance of them. I believe this borer is getting more numerous, and I hope you will be able to find a sure preventive remedy."—C. E. FISHER.

All the specimens of bark sent contained living beetles, and those in the cherry bark were the true Peach Bark-borer. Careful examination of the sections of wood sent by Mr. Fisher, as well as by Capt. Sheppard, some of which have been kept in closed jars in my office for nearly a year and in which there are still living beetles, and also field observations at Queenston, show that this beetle works entirely in the bark, where all

the stages are passed. I have not found a single instance where the wood has been penetrated.

"Queenston, March 13.—I examined the trunks of the trees, as you suggested, on a sunshiny day and found beetles crawling with their wings set for flying. You know, ordinarily they do not appear as if they had wings, and those I saw had their wings out ready for use. I will try the alkaline wash, and the first wet day we have when the gum is soft, I will try the brush and emulsion. I believe that, unless these beetles are checked in some way, they are likely to be very troublesome and the cause of much loss to peach growers, as they undoubtedly, to my mind, will destroy the trees unless interfered with."

"June 1.—The peach-bark beetles I have been doctoring with linseed oil. I covered the entire trunk. The first tree, which you saw, to which I applied it, seems as thrifty as any one of the others; it is full of fruit. To two I applied the coal oil; one of them around which I placed a cloth to cover the trunk, at your suggestion, is dying; the other, left exposed, is all right. This contains instruction, I suppose. Those to which I applied the whitewash, have not been free from attack. The linseed oil and coal oil trees have not been bothered since. I shall let you know later how the trees get along, and the beetles also."—C. E. FISHER.

I visited the orchards of Mr. Fisher and Captain Sheppard on April 16th last, just before the buds burst, and found that the beetles were very active and crawling over and boring into the bark in large numbers; but no eggs nor larvæ were found then. Young larvæ were found in the breeding jars in my office at Ottawa early in June, from which the perfect beetles emerged in large numbers in the last week of July and into August. I am of the opinion, although I failed to trace it this year, that there is a second brood from eggs laid in August, which matures before winter and hibernates as perfect beetles in the bark. I have found perfect beetles in the bark from November till April, young larvæ in June, pupæ in July, perfect beetles by July 27 and through August.

In a letter to the *Rural New Yorker*, Mr. Slingerland, of New York State, says: "Eggs have been found in May and July, larvæ and pupæ in July, adults in April, May, July, November and February."

On the appearance of the summer brood, the following letter was written to Mr. Fisher:—

"Ottawa, July 27.—Quite a number of Peach Bark-borers have appeared to-day in the breeding jars. This would look as if the eggs laid this spring had now matured and a brood of beetles was issuing from these eggs. Will you please examine your trees and see if the beetles are not abundant on them just now, running over the bark and sinking fresh burrows? It was supposed that there is only one brood in the year, but the above would certainly look as if there were two, at any rate. I notice that the beetles are pairing, and I imagine eggs will be laid and another brood mature from these eggs this autumn, and pass the winter in the bark, where they will remain until next spring. Please give me your opinion on this."—J. F.

"Queenston, Oct. 15.—Those little Peach Bark-borers have been working worse than ever. First, about the treated trees: Two I treated with pure coal oil; I covered the trunk of one with a sack as you suggested; it died first; the other followed suit about two or three weeks later. The one treated with linseed oil died also, but not until the fruit had about half come to maturity. Those I treated with whitewash and whitewash with Paris green, lived, but became infested with the beetles again after the wash was partially carried away by the rain, and did not do well at all; in fact, they look so bad that I have decided to take them all out and burn the trunks. I treated a large number of trees with the boiled linseed oil, covering the trunk entirely of some of them, of others only in places where beetles had secured a lodgement. All these trees were treated, you remember, after the season was more advanced than when the first one was treated. Those that were healthy, did not seem to be injured by the oil. They passed through the season as well as those with no oil application. Some that were sick, succumbed quite early in the season. I think they were unhealthy at the start. You will gather from this what my conclusions would be. A healthy tree would stand

the linseed oil all right, put on lightly, not thoroughly saturated, after the trees are out in full leaf, but not before. The linseed oil will kill the beetles, but after a time they will trouble the tree again if some are left anywhere. I noticed this, which you may probably know, that old trees, say nine or ten years planted, are more likely to be troubled with the beetles; still, when numerous, as you saw, they attack young trees. The whitewash was not effective. I was thinking, would it do to add to the whitewash carbolic acid sufficient to make a strong odour? Some bugs are sensitive about bad smells. Would this injure the tree? And would it kill the bugs, do you think?

"In reply to yours of July 27th, I examined my trees and found early in August the beetles running over the bark and sinking fresh burrows. About the middle of August they are very numerous, so much so that on a small tree only two inches in diameter, I killed 64 beetles in about 15 or 20 minutes, about sun-down. They must certainly have been a fresh brood, so numerous were they. I believe, with you, that beetles will mature from the eggs laid this autumn and pass the winter in the bark."

"December 31.—We found the beetle active during mild weather in February last, and in this December they worked nearly the whole month.

"Now, my opinion is, that it is dangerous to use coal oil, or linseed oil either, on peach trees before they have the rough furrowed bark. I have several other trees now which I observed this morning, to which linseed oil was applied freely; one I noticed was about dead, a seven year old smooth bark; several others, a year older, partially dead, all smooth bark; others older, rough bark, apparently all right. I think, notwithstanding what you have heard concerning application of coal oil for San José Scale, that it will have to be used with great caution. I regret it very much, too, it is so easily applied and so effectually disposes of them."—C. E. FISHER.

The following letter refers to the same subject:—

"Queenston, December 20.—In reply to yours of the 17th instant, I would say that the Peach Bark-borer can injure seriously, and if not interfered with, will kill peach trees about the third or fourth year after the attack begins. I think all the experiments I have tried have had some good effect; but none have been quite successful. I have used coal oil emulsion applied with a spray pump; also, whitewash and Paris green applied in the same way; also, plain whitewash applied with a brush, and of different degrees of thickness. All the applications seem to check the work of the borer. The Paris green and whitewash, sprayed with force, and the thick whitewash, seem to give the best results. I applied the whitewash and Paris green twice, the whitewash once. I have been told that this borer is known as the Elm-tree Bark-borer, and I notice that they seem to attack peach trees standing near forest trees, more frequently."—CAPT. JAMES SHEPPARD.

The Peach Bark-borer, and the Elm Bark-borer (*Hylesinus opaculus*, Lec.), although at one time thought to be identical, are entirely distinct, as can be seen at once by examining the antennae. In the case of the former, the club of the antennae is composed of three separate flattened joints or plates opening like the leaves of a book; although very small, these are easily distinguishable when the insect is moving. In the Elm Bark-borer the club is slightly compressed, ringed, pubescent and oval pointed. This mistake was first made by Dr. Harris many years ago, and was repeated by subsequent writers until attention was drawn to it by Mr. E. A. Schwarz, of the Department of Agriculture at Washington, who has made a special study of the *Scolytidae*, and who has examined the specimens upon which Dr. Harris based his statements.

The above extracts show that a certain amount of success has attended all of these experiments; and, although some important facts have been found out with regard to the life history of this serious enemy of the peach, particularly as to the early date when the beetles are active and the comparatively long time before the eggs are laid in the spring, yet further investigations are necessary to discover the best treatment and the most suitable remedy. Arrangements have been made for further experiments next season. From the work of Mr. C. L. Marlatt, in fighting the San José Scale, as detailed in *Insect Life*, VII, page 116, it would appear that coal oil emulsion of a much greater strength than was tried in Mr. Fisher's orchard, may be applied with safety to peach trees, and it is just possible that the death of Mr. Fisher's trees may have been due to

some other cause than the applications made to destroy the borers. He has kindly consented to take up the investigation again next spring.

There is no doubt that this is a difficult insect to control, and the usual recommendation has been, in cases of bad attack, to cut down the trees and burn them. It seems to me, however, that less heroic measures will be found to meet the case; for, although this pest is very destructive in certain parts of the orchards in the Queenston district, a great many of the trees are only slightly attacked and the wholesale destruction of them would entail much unnecessary loss. I believe that frequent applications of weak insecticidal or preventive washes, perseveringly made at regular intervals from the beginning of March to the end of May, and again when the beetles appear in July and August, would prove effective.

The greatest success may be expected from ordinary Kerosene emulsion (Riley-Hubbard formula), reduced with 15 parts of water, linseed oil, whitewash and Paris green, enough of the latter to give the wash a green tinge; whitewash and carbolic acid, one ounce to a pailful of wash; and particularly the ordinary "Saunders Wash," which consists of soft soap reduced to the consistence of thick paint by the addition of a saturated solution of washing soda in water. If applied during the morning of a warm day, this will dry in a few hours, and form a tenacious coating not easily dissolved by rain. As a preventive wash, this has been found excellent upon young apple trees, and should be applied to all fruit trees as a regular horticultural method every year. It could not injure even young peach trees. I believe that a satisfactory remedy for the Peach Bark-borer will depend largely on beginning operations early enough in the spring. Our present knowledge of the subject would indicate the 1st of March to be about the proper date.

Since the above was written, the following important communication from G. C. Snow, New York, to the *American Agriculturist* has appeared in their issue of January 5, 1895:—

"Experience with the Shot-hole Peach borer."

"Two years ago I had several peach trees infested with the Shot-hole borer of the peach, strong, well loaded early Crawfords. Under directions given by Dr. Lintner I applied kerosene with an atomizer twice thoroughly, the object being to get the kerosene in the holes as far as possible. The application was from the ground up to and as far on the large branches as the beetles were at work. The trunk was saturated. The kerosene, apparently, did not kill the beetles or injure the trees. There were five infested. However, one tree ripened its fruit prematurely, presenting all the characteristics of the yellows, except habit of growth. That tree died in the fall, I believe, from the damage by the beetles, the other trees ripened their fruit at the proper time, but it was of no flavour or value, though fairly good in appearance. These trees came out as well as ever the next spring and are in fine health yet. Some other trees were slightly affected at that time. Since then I have had no trouble from the attacks of the beetles. I wash all trees thoroughly in the spring with the usual material, with the addition of carbolic acid."

THE SPOTTED PARIA.

(*Paria sex-notata*, Say, Fig. 17).



Fig. 17.—The Spotted Paria, life size and enlarged.

Attack.—Small, shining brown beetles, shaped as in the figure — $\frac{1}{8}$ of an inch in length; varying much in colour and markings, but in the commonest form having honey-yellow wing-cases, each bearing two large black blotches; thorax reddish brown; eyes black; legs yellow. In many specimens the markings cover the greater part of the wing-cases; and in some, not only the wing-cases, but the thorax as well, is entirely black. All of these varieties occur together on the same plant.

The attacks reported this year have been only on raspberries, but occasionally the strawberry also is injured. The damage is done early in the season at the time of the bursting of the buds of the raspberry, and is frequently serious.

Depredations by this insect have been reported to me many times during the past three or four years; but I have held the matter back, hoping to be able to work out the life history. So far, however, I have been unable to obtain eggs or any definite information in Canada except with regard to its injuries. An interesting account of *Paria aterrima*, Oliv., which seems to be extremely similar if not identical with this species, occurs in Prof. Forbes's *Insects affecting the Strawberry*, 1883; but as there are certain dates in that account, that I cannot reconcile with our Canadian observations, I had hoped to obtain material to breed the species through all its stages and compare them: but so far I have been unsuccessful. If *Paria sex-notata* proves really to be a distinct species from *Paria aterrima*, there is little doubt that, like that of the latter, as described by Forbes and Cook, the larva feeds on the roots of strawberries and raspberries. Attention is drawn to this insect now at the request of some of the members of the Fruit-Growers' Association of Ontario. The Spotted *Paria* does not attack the raspberry alone; for in 1874 Mr. John McGrady, of Gatineau Point, Que., suffered a disastrous attack upon his strawberry beds, many of the plants having the leaves completely devoured and the crop ruined. It was found that hellebore was quite useless against the enemy, and later experience has shown that much stronger poisons are necessary against this beetle than for many others. The beetles appeared suddenly and disappeared again as suddenly about ten days later. For three seasons past, the Spotted *Paria* has been the cause of much loss in some raspberry plantations in the Grimsby, Ont., district. On May 1st, Mr. Linus Woolverton wrote:—"I send you some specimens of a little beetle occurring here in large numbers in our raspberry plantations eating up all the buds. Please say what it is and prescribe a remedy. We fear some plantations will have no fruit left." The following letters from Mr. Martin Burrell, of St. Catharines, Ont., a careful experimenter and successful fruit-grower, will show how difficult an insect this is to combat:—

"May 13, 1891.—Will you kindly give me the name and general habits of the inclosed beetles? My raspberry canes are literally infested with them and I think I am not overstating when I say that one-half of the buds have been eaten and nearly all the young leaves punctured.

"Their very objectionable method of work seems somewhat similar to that of the Grape vine Flea-beetle, but this, apparently is rather as far as jumping goes; for, when detected, he immediately turns over on his back and rolls on to the ground curculio fashion. I sprayed my patch yesterday morning at the rate of 2 ounces of Paris green to 40 gallons of water, but the beetles are still in great force; though possibly 24 hours is not long enough for the poison to take effect. Some blackberry canes adjoining the raspberry patch are scarcely touched by them."

"May 26, 1891.—Many thanks for your kind letter of the 16th inst., identifying the *Paria* beetle for me. They are most troublesome, and were apparently quite as cheerfully active after two sprayings with Paris green as before. I have given them a third spraying—4 ounces to 40 gallons—and even this did not completely rout them, tho' a slight rain 24 hours after spraying may have prevented the poison doing its work fully. The raspberry canes are so far advanced now, however, that I fancy the beetles can do little harm, unless in the way of providing another crop of the pests for 1892."

"Dec. 30, 1891.—I found that *Paria sex-notata*, which you kindly identified for me, very difficult to destroy; the little villains very seriously injured my raspberry crop and it would certainly take as much as 4 ounces of Paris green to 40 gallons of water to affect them."

"Feb. 17, 1892.—With regard to your inquiry as to my spraying for the *Paria*-beetle last year, I find in my note book:—

"May 11.—Sprayed raspberries for beetle with 2 ounces of Paris green to 40 gallons of water.

"May 14.—Beetles still thick; only found two dead. Sprayed again 3 oz. to 40 gallons, comparatively ineffective.

"May 20.—Sprayed again 4 to 40, as the beetles were still very thick."

"I find that rain fell 24 hours after the last spraying and I presume partially destroyed its efficacy. I cannot find that I sprayed again, but my impression is that even this dose did not completely fix things; but by this time I think the leaves had pushed on so far that the beetles could not do much damage. As to the effect on my crop, I am perfectly safe in saying that at least one-third of the crop was destroyed, in many cases every bud on the cane being eaten out. I found that the beetles were generally very shy and wary, on being approached, running to the edge of the leaf and rolling off, or else turning over on their backs and simulating death."

"May 20, 1892.—My old enemy, *Paria sex-notata*, has revisited me this spring in greater numbers than ever. I sprayed with Paris green 4 ounces to 40 gallons, but the foe still bobbed up serenely. To give you some idea of the damage it has done me this year, I may state that out of a quarter of an acre of raspberries not a score of canes have leafed out. I am not the only victim this year, as several of my neighbours have been seriously injured by the beetles; I strongly suspect that their canes were more or less injured last year, but they do not seem to have been aware of the existence of the beetle, and some even this year failed to attribute the damage to the right cause. Where the patches are badly affected, I have advised taking out root and branch and burning, and presume this to be the best course. Do you know how many eggs the beetle lays? Or have you in any way traced out its life history?"

"I might mention that I found one specimen eating a grape vine bud. Is this new to you?"

Mr. John Craig, the Horticulturist of the Central Experimental Farm, found this insect early in May last injuriously abundant in raspberry plantations on the road between Hamilton and Grimsby.

Mr. Adolphus Pettit, of Grimsby, stated that it was in great numbers on a neighbour's raspberries, working on the unopened buds and young leaves, and it occurred on many other fruit farms.

Remedies.—The Grimsby fruit growers were recommended to dust the bushes at once with Paris green and slaked lime, or some other quite dry powder, 1 pound of the former to 25 pounds of the latter. This mixture is easiest applied by putting it into a

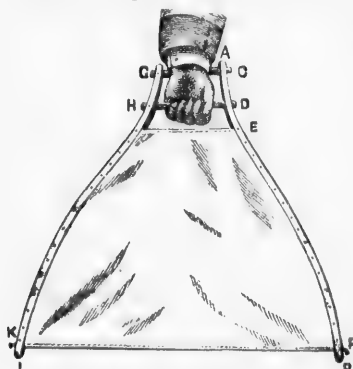


Fig. 18.—Beating net.

bag of cheese cloth and shaking or tapping it over the bushes. Of course, if this can be done when there is a dew, it is so much the better. Owing to the difficulty of destroying these beetles with poisons and the small quantity of foliage on raspberry bushes at the time of attack, perhaps the most practical remedy will be found to be beating the insects off into a beating net, a light wooden frame with cotton stretched tightly between the side pieces (Fig. 18), and then destroying them by throwing them into some vessel holding water with a little coal oil on the top. An easy plan for collecting them is to hold an open and inverted umbrella beneath the canes when beating them, and then brush the insects out into the coal oil pan.

In a report which Mr. Woolverton has been kind enough to send me on the injuries to fruit crops by insects during 1894, he says:—

"The Spotted *Paria* was very troublesome about Grimsby this spring, eating out the buds of the raspberry, and thus materially reducing the crop. I have made public the remedy you prescribe, and it will be tried faithfully next season by our growers."

I shall be obliged to any fruit grower who, next season, will notify me promptly of the occurrence of this insect on its first appearance, and send me living specimens for study.

THE APIARY.

In the autumn of 1893 arrangements were made, in response to several representations made to the Honourable Minister of Agriculture, to institute an Apiary at the Central Experimental Farm. At that time, 10 swarms of the Common Black Bee were purchased. In the spring of 1894 a suitable space was chosen near to the house of Mr. John Fixter, the farm foreman, who had some experience in the care of bees, and who undertook the practical management of the apiary. He has had the sole charge of the bees during the season, and has carried out most carefully with the assistance of his brother, Mr. George Fixter, such experiments as I considered it wise to undertake the first year. I beg to acknowledge gratefully much assistance and valuable advice received from Mr. R. F. Holtermann, of the Goold, Shapley & Muir Co., Limited, Brantford, and Editor of the *Canadian Bee Journal*. In consulting with Mr. Holtermann as to the most useful experiments which could be undertaken with such swarms as we had and under the existing circumstances in our apiary (with which he was well informed) he was good enough, not only to suggest a useful line of experiments to compare the different kinds of foundation comb used by beekeepers in the Dominion, but himself to prepare the foundations for these experiments.

On receipt, these specimens of foundation comb were kindly weighed accurately by Mr. Frank T. Shutt, the Chemist of the Dominion Experimental Farms, and then at the end of the season were again weighed after the honey was extracted. Mr. Shutt has been good enough to prepare a report submitted herewith on these comparative weighings, and has drawn some deductions therefrom which will be read with interest. I also submit an interesting report on the management of the apiary by Mr. Fixter.

The two Italian queens referred to, which were substituted for two of our own, were of a race procured from Mr. Holtermann, of which he says: "They are of a set very light in colour which are at present so freely praised on one side, and on the other as freely condemned. It would be a good experiment to try them at Ottawa for wintering as well as for worker qualities next season."

The annual meeting of the County of Russell Bee-keepers' Association was held on October 16, at Chard, Ontario. This meeting was attended by Mr. Fixter, and he gave an account of the work being carried on with bees at the Central Experimental Farm, which was listened to with pleasure and interest.

We have now in the apiary 20 hives of bees, and preparations have been made for repeating the experiments undertaken this year with foundation combs, with different bee-fodder plants, and as to the best method of preventing injury of the bee-moth. I append herewith reports prepared at my request by Messrs. Fixter and Shutt.

REPORT OF MR. JOHN FIXTER

First steps were taken in the Bee department in the autumn of 1893, when several swarms were purchased. They were weighed in the autumn before being put into the cellar, and again in the spring of 1894. In spring they weighed on an average 20 lbs. less per colony; this reduction is considered large and resulted from the temperature of the cellar being very low during the winter which necessitated the bees consuming more honey than if the cellar had been a few degrees warmer. During November and December, 1893, the temperature varied from 34 to 38 degrees Fahr.; during January, 1894, 32° to 34°; February, 32° to 34°; March 38° to 40°; April 1st to 12th, 40° to 48°. These temperatures are considered too low; from 40° to 46° has been found the best temperature for the whole winter. On April 12th, 1894, the bees began to get uneasy, and, the weather being very fine, they were taken out of the cellar and placed on the summer stands. The first ten days they gathered pollen very freely; after that a very

cold wet period set in and lasted several days, when it was found necessary to feed several of the swarms with syrup (2 parts of granulated sugar and 1 part of water) put moderately warm into a Miller feeder and fed in the evening. Swarming began June 14th. The increase in the number of colonies was very small, and the honey flow of the past season has been poor, not only in the Ottawa district, but in many parts of Ontario and Quebec; several bee-keepers have stated that the past season has been the poorest for many years. The apiary on the farm gave an average of 23½ lbs. of honey per colony. There was very little honey gathered from clover this season, the bees made most of their store from the basswood (or American Linden) and the honey did not increase in weight after the basswood ceased to flower. No honey was gathered by our bees from buckwheat, as there are no fields of this crop within several miles of the farm. In the experimental work with foundation combs, the following swarms were selected for the experiment: No. 20 was a swarm that came off a colony of Common Black Bees on June 23 and weighed 9 lbs.; No. 21 was partly Italian and partly Common Black Bees, both swarming together on June 24; the weight of this swarm was 9½ lbs.

On August 4th two thoroughbred Italian Queens were presented to the farm by Mr. Holtermann to be introduced into the apiary. Two hives of Common Black Bees were selected that had a good quantity of honey and brood, with young bees just coming out. The old queens and 12 workers with each, were first taken from the swarms and put into a cage, until it was found that the Italian queens had been accepted by the swarms. The Italian queens were introduced as soon as the old queens were taken away, the cage being placed lengthwise on the top of two frames of honey and brood, the bees being allowed to eat their way through about one inch of honey and sugar before the queens could get out. Drone traps were placed at the entrance, so that if the queens attempted to leave, or if any attempt was made to carry them out, they would be easily seen. Both swarms took kindly to their new queens, and 27 days afterwards young Italian workers were noticed.

September 24th: the hives were all weighed and several were found to be short of stores to carry them through the winter. All hives that did not weigh 50 pounds were fed, September 27th, with a syrup, two parts of sugar and one of water, fed moderately warm, in the evening, in a Miller feeder; 6 swarms before being fed weighed 214½ lbs., and were given 116 lbs. of syrup. In 18 days afterwards they were weighed again and weighed 297 lbs., making 33½ pounds less weight than was fed. On November 9th the hives were all weighed again, immediately before being put into the cellar. These same six swarms weighed 286 pounds, being 11 pounds less than on October 12th. This experiment indicates that a person feeding should allow about one-third more syrup than the weight required to make up each hive to 50 pounds.

The temperature of the cellar, November 2-30, 1894, varied from 40° to 44°F.

REPORT UPON AN EXPERIMENT WITH SOME BRANDS OF "FOUNDATION," BY FRANK T. SHUTT, M.A., F.L.C., F.C.S.

Wax, like honey, is a true secretion and not a material gathered by the bees, special cells or glands having for their function its production. It differs from honey, however, in its formation in certain particulars. Honey would appear to be the result of the action of a diastase or ferment, produced by certain cells in the bee, upon the cane sugar contained in the nectar gathered from flowers. Wax is manufactured, so to speak, in the bee, and is the result of the physiological function of certain glands, as already stated. Wax, therefore, is produced at the expense of the honey or sugar (as the case may be) consumed by the bee. Thus Dumas and Milne-Edwards found that bees fed with 500 grammes of sugar produced 30 grammes of wax, the same weight of honey only yielding 20 grammes. It would also appear that although pollen is not absolutely necessary to the production of wax, its consumption by the bees greatly reduces the amount of honey or sugar otherwise required (Berlepsch). From this it is evident that wax is secreted, primarily at the expense of the tissue and, secondarily, of the food consumed.

In supplying "foundation" to the bees, the object is to save much of this expenditure, and thus allow the bees more time and energy for the production of honey.

The primary object of the present series of experiments, as suggested by Mr. Holtermann, was to ascertain the relative ease with which the various foundations tested were drawn out and used by the bees; it, naturally, being held that those would be the most profitable which were utilized in this way to the greatest extent by the bees, or, in other words, those to which the least wax was added by the bees in building the comb. It will be seen that other and perhaps more important results have been incidentally obtained.

The experiments were conducted as follows:—

The frames were filled with the various foundations under test, and the exact weight of two inches square, noted. At the close of the season a similar area of two inches square was cut out of the centre of the full comb, the caps of the cells carefully removed and the honey, was extracted with the extractor and finally by successive exhaustions with cold water. The empty honey-comb was finally allowed to dry in the air and was weighed.

The following tables give in consecutive form the data obtained and the averages therefrom.

EXPERIMENTS with Various Brands of "Foundation," 1894.

Designating Letter.	Name of Wax and Mill.	Milling Temperature.	Weight in grammes of "foundation," 2 inches square.	Weight in grammes of empty honey-combs, 2 inches square.	Weight in grammes of wax added by bees, per 2 inches square.	Percentage of wax added by bees.	Approximate measurement of one pound.
A.	Choice wax, Root mill, outer section.	89 F.	1.4010	2.8325	1.4325	102.2	9.0 sq. ft.
B.	" " " "	89 F.	1.4010	3.0804	1.6830	120.1	
C.	" " " "	120 F.	1.2040	2.6025	1.3985	116.1	
D.	" " " inner section.	120 F.	1.2040	2.8635	1.6595	137.8	10.5 "
E.	Foundation in general use, outer section.		1.4145	2.5650	1.1505	81.3	8.9 "
F.	Foundation in general use, outer section.		1.4145	2.4805	1.0660	75.3	
G.	Heavy sheet, Root mill, outer section.	120 F.	1.3157	2.8165	1.5008	114.0	9.6 "
H.	" " " inner section.	120 F.	1.3157	2.6750	1.3593	103.3	
I.	Inferior wax, Root mill, inner section.	120 F.	1.1670	2.5340	1.3670	117.1	10.8 "
J.	" " " outer section.	120 F.	1.1670	2.5050	1.3380	114.7	
K.	" " " " "	89 F.	1.2240	2.5410	1.3170	107.6	10.8 "
L.	" " " inner section.	89 F.	1.2240	2.8060	1.5820	120.2	
M.	Choice wax, Given press, inner section.	120 F.	1.8010	3.0565	1.2555	60.1	7.0 "
N.	Patent process, 12 sq. feet, inner section.		1.0040	2.7665	1.7625	175.5	12.5 "
O.	Patent process, 15 sq. feet, inner section.		1.0930	2.9115	1.8185	166.4	11.5 "
P.	Inferior wax, Given press, inner section.		1.5820	3.0090	1.4270	90.0	8.0 "

cally to the economy of supplying the bees with a foundation of not more than seven and a half feet to eight feet to the pound.

3.—That a dark or deeply coloured foundation gives a dark and unsightly "fish-bone" in the resulting comb, materially affecting its palatability and injuring the sale.

4.—That in addition to what has already been said, there appears to be some support to the theory that certain waxes are more easily worked and drawn out by the bees than others. The results obtained in the experiments with the "foundations in general use" and the "inferior waxes" from the Root mill, would, apparently, lend weight to this view. The facts at our command do not at present allow of any general conclusion being arrived at on this point. There can be no doubt, however, that this factor cannot, in view of the data here given, be of equal importance with that of the weight of wax supplied to the bees in the foundation.

5.—That the present experiments give no definite results that would enable us to draw conclusions as to the relative merits, as regards working by the bees, of wax milled at high and low temperatures.

It might be urged from what has already been said, that it would be economical to supply all the wax necessary for the construction of the comb. There are, however, no facts to support this extreme view. The production of the wax by the bees is a normal function, and its entire cessation might possibly affect the honey yield or lead to a disarrangement of the general health of the bees. There is probably a limit in the amount of wax that can be advantageously furnished as foundation, a limit to be ascertained by future experiments.

SOME SPECIALLY NOXIOUS WEEDS.

Of the many weeds which have been sent in for identification or inquired about during the past year, there are a few which require more than a passing notice just now. Great attention has been given to this most important subject by the superintendents of all of our branch farms. Mr. S. A. Bedford, of Brandon, has forwarded for identification many specimens from farmers in his district, and has done good work in speaking at meetings on the practical treatment of these agricultural pests. Mr. Bedford has besides prepared for exhibition to farmers, specimens of the more injurious weeds. Mr. Angus Mackay, of Indian Head, has done excellent work in the same line, and has collected for the North-west Assembly specimens of Tumble Mustard, French Weed and others, for exhibition purposes. Mr. Thomas Sharpe, of Agassiz, states that there is a good deal of interest shown by farmers in British Columbia about noxious weeds. He thinks that many of these plants are being introduced in packages of trees, stock cars, etc., and has asked that a collection of mounted weeds might be supplied him for exhibition, as many of the farmers do not know the appearance of some of the worst weeds until these get to be a serious pest, and eradicating them is a costly undertaking. Col. W. Blair writes in a similar strain from Nova Scotia, and among other things reports that the Corn Spurry (*Spergula arvensis*, L.), lately recommended by some as a fodder plant, is one of the very worst weeds in his province. I would draw particular attention to the following imported weeds which call for special efforts.



Fig. 19.—The Russian Thistle: a branch of a mature plant.

pression that this was the first record of the occurrence of the pest in Canada, but I find, from an extended report by Mr. A. K. Leith, the Inspector of Noxious Weeds, of the Manitoba Department of Agriculture and Immigration, an advance copy of which has been kindly placed in my hands through the courtesy of the Hon. Thomas Greenway, Minister of the Department, that the Russian Thistle was first noticed five years ago on a farm occupied by one Peter Rhimer; but it was not till three years ago that it spread far over the district. Under instructions from the Hon. Thomas Greenway, Mr. Leith has made a very thorough search through those districts of Manitoba, where it was thought that the weed was likely to occur, and has explained to the settlers the danger of neglecting this enemy. He has also, by order of the Provincial Government, taken such steps as were possible to bring about its extermination. The weed was found in surprising quantities in some localities, as around Morden, where "it was so thick and dense that the crop was entirely choked out. On a piece of land of about five acres, a farmer, Abram Wiebe, cut with a mower and raked up over 90 cocks as large as good sized hay cocks which after drying out, he burnt." Mr. Leith went through the Mennonite reserve and found the pest all through the country in a greater or less degree. The way it was scattered seemed to indicate more that it had

THE RUSSIAN THISTLE or Russian Tumble-weed (*Salsola Kali*, L., var. *Tragus*, DC., Fig. 19) referred to in my last report, was detected in July last in Manitoba. Immediately on receipt of specimens, I prepared for distribution to the farmers of Manitoba and the North-west Territories a short bulletin (Experimental Farm Notes, No. 4) giving an illustrated description and concise history of the weed, and suggestions as to the best steps to be taken to prevent its spread. At the same time, the Manitoba Government adopted vigorous measures to fight this terrible pest of the Dakotas and some of the other North-western United States. The farmers of the west, and in fact of the whole Dominion, seem to be thoroughly aroused and to recognize the danger of neglecting this enemy. This is evidenced by the very large number of letters of inquiry and specimens sent in to see if they were the Russian thistle. These specimens were for the most part the true Tumbleweed of the west, *Amarantus albus*, L. from Manitoba, the North-west and British Columbia, and *Sonchus arvensis*, L., from Ontario and Quebec.

Although I have made inquiries from correspondents in Manitoba during the last two years as to whether they had observed any plants of the Russian Thistle, I could not learn of its occurrence in Canada until July last. However, Mr. James Dale, of Grund, Man., sent me in the beginning of September, old stems of the previous year. I was under the im-

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been spread in seed grain than by its natural manner of rolling. Very little indication of it was found on the natural prairie, except where there was loose earth around gopher holes. The Mennonites all know the plant, but, as a rule, are indifferent whether it is on their land or not, although a few seemed anxious to secure its extermination. The farmers of Manitoba are to be congratulated on the vigorous manner in which the endeavours to exterminate this weed have been prosecuted by the Provincial Department of Agriculture. In addition to the many localities where the Russian Thistle was found on the Mennonite reserve, small patches were also discovered at Carman, Souris, Wawanesa, Belmont and Baldur, all of which were carefully destroyed by order of the department. Although I do not think it at all likely that the Russian Thistle will become a dangerous weed in Ontario, where it has little chance of "tumbling," it may be well to state that vigorous specimens have been found along the Grand Trunk Railway, south of Lake St. Clair by Mr. J. Dearness, of London; at Toronto Junction, in the Canadian Pacific Railway yards, by Miss Zelma Bogart; and at Smith's Falls on the same railway, by Prof. John Macoun.



Fig. 20. The Russian Thistle: a young stem before the flowering period, natural size and a single seed enlarged.

The Russian Tumble-weed or Thistle will be easily recognized from the figures of a mature branch, an immature branch and seed shown herewith (Fig. 20). The plant most frequently mistaken for it is the true tumble-weed, *Amarantus albus*; but the two can be at once distinguished by the fact that, when the plants are immature, the leaves of the true tumble weed are expanded into a blade half an inch across, while those of the Russian Thistle are thread-like and fleshy. When ripe, the seeds of the former are lens-shaped, black and highly polished, not more than $\frac{1}{3}$ of an inch in diameter, while those of the latter are, shaped as in the figure, dull gray and nearly $\frac{1}{2}$ of an inch in their greatest length.

Some other western weeds have attracted attention by their aggressiveness during the past season. Mr. A. Mackay writes from Indian Head:—"I can safely say that one half of this farm was literally covered with plants of the TUMBLE MUSTARD, *Sisymbrium sinapistrum*, Crantz, blown in from adjacent farms on November 14, last. By good luck, the greater part of this was fallowed last summer, and I hope not many plants will appear next year in the crop. In 1893 there was not a plant in this whole lot. This year when we ploughed the field for the first time, it was a mass of flower, and the plants were so thick that every foot was covered with the weed. The tree plots, garden plots and all places of that nature were filled up, and continued so till the frost came. Of course, we ploughed, hoed, scuffled, as each new crop came up, and kept them from going to seed. But with fresh importations from the same quarter this fall, I have no doubt there will be plenty again next year. All our crops had more or less plants in them. We pulled them whenever it was practicable; but some places were so bad that we did not touch them until the grain was ripe. The plant is easily killed by fallowing the land, but it is spreading fast in the direction of the prevailing winds. Our council has power to cause the destruction of this weed, and likely will take steps the coming year to do so. If something is not done soon, this whole country will be overrun. Russian Thistle has not made its appearance here yet, and I hope it will not; but, as a weed, it is not any worse than our own tumble weed."

There is another member of the Mustard family which is just getting a footing in the North-west Territories as a noxious weed, *i. e.*, *Erysimum orientale*, R. Br., which has been sent to me by Mr. Mackay, from two or three localities in the same district, and from Beulah, Manitoba. Mr. Mackay says under date of August 29: "The weed *Erysimum orientale* is not on the farm, but is found five miles from here, and has caused considerable loss to the farmer on whose place it has obtained a foothold. I think it is only

on this one farm, and has been there for six or seven years. I send you seeds, young plants just starting and full grown specimens, all collected together." This plant is a slender branching annual with grayish green succulent leaves, on the stem oblong oval in shape and clasping at the base: the root leaves are spatulate, more elongated and not clasping at base. The flowers are small, of a creamy white, and borne at the tips of the branches; they are followed by square pods sometimes three inches in length, containing rather large blackish seeds. From what we know of this plant, there is every indication that it may develop into a troublesome weed, and it requires to be watched. This remark also applies to two other members of the Mustard family, which are every year becoming more abundant, *Neslia paniculata*, Desv., and False flax (*Camelina sativa*, Crantz). The name given in English books for this weed is "Hare's Ear Mustard."

PERENNIAL SOWTHISTLE, Field Sow-thistle (*Sonchus arvensis*, L.). There are, I believe, in the older portions of Canada few noxious plants which are spreading more rapidly and doing more harm than the Perennial Sow-thistle. It is alarmingly abundant through the province of Quebec and throughout the Maritime Provinces. It is a perennial with strong underground stems, which spread out a long distance from the centre. The leaves cover the ground closely and choke out the crop among which the plant grows. The flowering stems, about three feet in height, have no leaves towards the top, where they bear three or four large yellow flowers, which are conspicuously glandular hairy outside and on the footstalks. The seeds are provided with a copious pappus of pure white silky down, by means of which they are blown long distances. At the time the small grains are in flower or a little later, this plant is easily detected in a crop, from the flowers generally standing up a few inches above the grain. As soon as the conspicuous flowers are seen, every stem as well as the rosette-like tuft of leaves around the base of the main stem, should be pulled. This can easily be done at this season, and as soon as the crop is harvested, the stubble should be ploughed. I am informed by Prof. E. A. Barnard, of Quebec, that in some places this plant is so abundant as to have acquired the name of *Crèves-yeux* (Hard on the eyes) from the necessity of covering the face with a veil when threshing grain to keep the particles of down out of the eyes. When this plant is once noticed in a piece of land, every effort should be made to eradicate it, and this requires the greatest care and perseverance.

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